S5200E DS3

DIGITAL TRANSMISSION TEST SET

RECEIVER
OPERATION MANUAL

FORM 0338-0585A

tau-tron
A UNIT OF
GENERAL SIGNAL

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DIGITAL TRANSMISSION TEST SET

RECEIVER
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(617) 692-5100 Telex 750245 1-800-TAU-TRON (Outside MA)

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SAFETY INFORMATION

Caution: This instrument is designed to operate from a single phase power source, with one of the current carrying conductors at ground. Operation from power sources where both current carrying conductors are live with respect to ground is not recommended.

Warning: To avoid dangerous electrical shock, do not perform electrical tasks when there are signs of shipping damage to any part of the instrument case.

Warning: Before the instrument is switched on, all protective ground terminals, extension cords, autotransformers and devices connected to it should be connected to a protective grounded socket. Any interruption of the protective grounding will cause a potential shock hazard that could result in personal injury.

WARRANTY

All Tau-tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-tron manufactured products. The warranty period for OEM products sold by Tau-tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction; see Repair Returns below.

SHIPPING DAMAGE

If any signs of damage are noted on the outside of the carton, request that the carrier's agent be present during unpacking. If external damage is found on the instrument, follow Repair Returns procedure below.

Check the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Returns procedure below.

REPAIR RETURNS

For mechanical damage or electrical malfunctions, notify Tau-tron immediately. If the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Department, (617) 692-5100, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.

2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.

3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb; 159 kg) and shock-absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.

4. Send to: Tau-tron Inc.
   10 Lyberty Way
   Westford, MA 01886
   Attn: Customer Service

S5200E DS3

DIGITAL TRANSMISSION TEST SET RECEIVER

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SECTION 1

INTRODUCTION

1. INTRODUCTION

A. General

1.01 This manual provides the user with all information required for the installation, operation, and maintenance of the Tau-tron S5200E DS3 Digital Transmission Test Set Receiver.

1.02 Whenever this manual is reissued, the reason for the reissue will be given in this paragraph.

B. Scope

1.03 The following information is provided:

- Equipment description
- Specifications
- Installation instructions and site requirements
- Operation instructions
- Theory of operation
- Maintenance.

C. Errors, Omissions, and Recommendations

1.04 We would appreciate your comments about any errors or omissions you discover in this manual. When reporting errors or omissions, please be specific and indicate the section number, title, and page number. Also, indicate the paragraph number, figure number, or table designation.

1.05 Your recommendations for improving the quality, contents, and usability of this document are requested and solicited. Please address all correspondence to:

Tau-tron Inc.
ATTN: PUBLICATIONS MANAGER
10 Lyberty Way
Westford, MA 01886

SECTION 2

DESCRIPTION

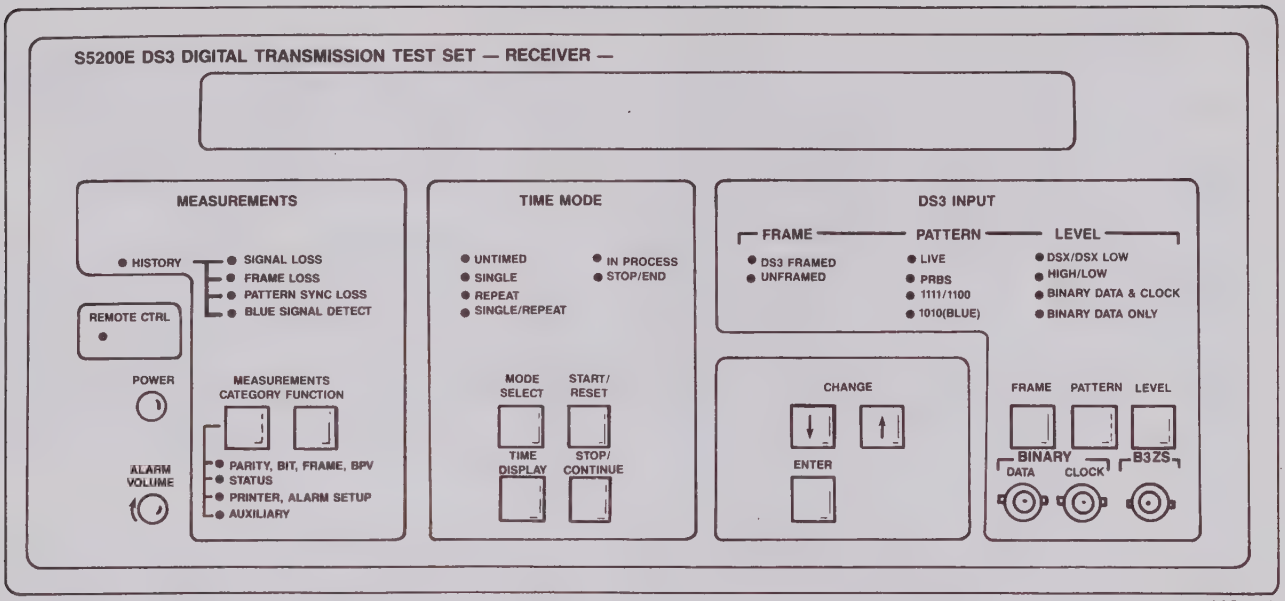
2. DESCRIPTION

2.01 The S5200E DS3 Digital Transmission Test Set Receiver together with its companion instrument, the S5200E DS3 Transmission Test Set Transmitter, form a compact test set for detailed measurements of systems operating at the DS3 transmission rate. The S5200E Receiver's sophisticated microprocessor-based technology provides ease of use and powerful capabilities for a wide variety of applications including: commissioning, routine maintenance, troubleshooting, long and short term system monitoring, engineering development and production testing of fiber optics, satellite systems, digital radio systems, digital multiplexers, protection switches, and cable systems.

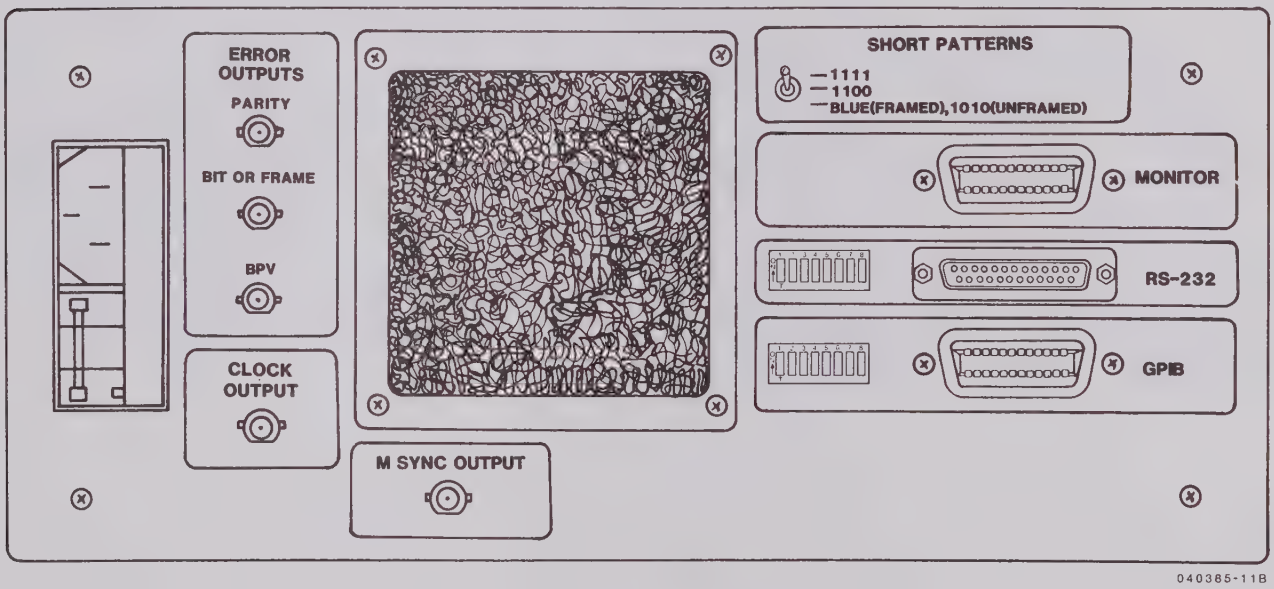
2.02 All measurements and computations are performed simultaneously with simple and direct answers provided through a 40-character front panel display. More than 30 simultaneous measurements are made for parity, frame, bit, BPV, and signal status categories. Measurements include: total errors, error-seconds, current error rate, percent of error-free seconds, average error rate, error seconds at different error-rate thresholds, dribbling error rate and total errors, logging of occurrences (event seconds) of a wide variety of signal status and alarm conditions from externally connected systems or site parameters.

2.03 Measurement versatility is enhanced by four different timing modes and by the optional IEEE-488 (GPIB) and RS-232C interfaces. These interfaces provide a remote control capability and measurement outputs to devices such as the Tau-tron 5902 40-column printer, important in many applications.

2.04 The S5200E operates with the standard B3ZS coded signals, with binary data and clock, or with binary data only, and measures framed or unframed signals with a variety of data patterns including live traffic. Operation with or without an external clock input is possible over a wide input frequency range because of the frequency/phase-locked timing recovery loop, tailored to communication system requirements. A proven DS3 framing algorithm and fast-feed-forward data synchronization technique allow the S5200E to acquire lock fast and minimizes the loss of synchronization in high-error-rate environments.



FRONT PANEL



REAR PANEL

Fig. 1 - S5200E Receiver

SECTION 3

SPECIFICATIONS

3. SPECIFICATIONS

A. General

3.01 This section describes all the specifications of the S5200E DS3 Digital Transmission Test Set Receiver.

TABLE A

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
BIPOLAR INPUT	
Frequency Range	44.736 MHz +/- 1.5 MHz.
Coding	Bipolar with 3 Zero Substitution (B3ZS).
Level:	
High/Low Input	Nominal High input is 0.91V peak to 1.82V peak maximum. Nominal Low input is 13.8 dB below High (0.19V peak).
DSX Input	Nominal DSX cross connect is High signal passed through the equivalent of 450 feet (114.3 m) of 728A cable. DSX input equalization is for 450 feet to 900 feet (274.3m) of 728A cable, typically 5 to 6 dB below High (0.48V peak).
Dynamic Range	Greater than 3.2 dB.
Sensitivity	Greater than 26 dB below nominal for High and DSX input.
Impedance	75 ohms with greater than 20 dB return loss from 1 to 50 MHz.
Connector	Accepts WECo 358.
BINARY DATA INPUT	
Frequency Range	44.736 MHz ±1.5 MHz for Binary Data Only mode. 44.736 MHz ±3.0 MHz for Binary Data and Clock mode.
Coding	Non-Return to Zero (NRZ).

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
BINARY DATA INPUT (CON'T)	
Input	500 mV peak-to-peak minimum, DC-coupled, internally strappable to AC-coupled. Normal 0V threshold, internally strappable to ECL or TTL thresholds.
Impedance	75-ohms.
Connector	BNC.
BINARY CLOCK INPUT	
Frequency Range	44.736 MHz ±3.0 MHz squarewave.
Input	500 mV peak-to-peak minimum, AC-coupled. Normal 0V threshold, internally strappable to ECL or TTL thresholds.
Impedance	75-ohms.
Phasing	Rising clock edge in center of data ± 4 ns.
Connector	BNC.
DATA PATTERNS	
PRBS	Repeating pseudorandom bit sequence of $2^{15}-1 = 32,767$ bits.
Short Patterns	All ones, Repeating 1010, Repeating 1100.
Blue Signal	Automatic recognition in framed mode.
FRAMING	
Framed	Bell-compatible DS3 framing format. Mean time to acquire frame of 2.6 milliseconds. Mean time to loose frame at 10^{-2} bit error rate of more than 800 hours.
Unframed	Measurements without DS3 framing format. Data synchronization less than 0.36 milliseconds.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
MEASUREMENTS	
General	All measurements made simultaneously with access through the front-panel, RS-232C and/or IEEE-488 interfaces, if equipped.
BIT, PARITY, FRAME, and BIPOLAR MEASUREMENTS	
General	Bit, Parity, and Bipolar Violation (BPV) measurements are made simultaneously for all data patterns in the framed mode. Parity, Frame, and BPV measurements are made simultaneously in the live DS3 framed mode. BPV measurements are made on DS3 signals and exclude legitimate B3ZS code violations. Bit measurements are made on data bits in the framed or unframed mode. Parity and Frame measurements are made on DS3 framed signals.
Total Errors	9-digit total errors plus overflow indicator.
Current Error Rate	Total errors per 10^8 data bits continuously measured every 10^8 bits, approximately 2.2 seconds.
Average Error Rate	Total errors per total received bits continuously measured over the elapsed time of test. Calculation to 10^{-16} BER.
Error-Seconds	Synchronously measured error-seconds with 7-digit output and overflow indicator. Non-synchronous for BPV.
Percent Error-Free Seconds	Percent calculation of total elapsed time less synchronous error-seconds relative to total elapsed time, calculation to 0.0001%.
Threshold-Error Seconds	Number of synchronous error-seconds in which rate exceeds thresholds of 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6}. Threshold of 10^{-3} invalid for parity measurements. Threshold of 10^{-6} invalid for frame errors. Not measured for BPV.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
BIT, PARITY, FRAME, and BIPOLAR MEASUREMENTS (CON'T)	
Dribbling Error-Total	Accumulated errors when error rate during synchronous error-second is less than 10^{-6}. Not measured for BPV.
Dribbling Error Rate	Error rate calculation of total dribbling errors per total elapsed time. Not measured for BPV or frame errors.
STATUS MEASUREMENTS	
General	Accumulation of the number of elapsed seconds during which an event occurred.
Single Event Seconds:	
Signal Loss	Absence of input or input below minimum sensitivity range.
Frame Loss	Loss of DS3 frame.
Sync Loss	Loss of data pattern synchronization.
Blue Signal Detected	Detection of blue signal in DS3 frame mode independent of data pattern selection.
X-bit Detected	Detection of logic low X-Bit.
External Event Inputs:	Detection of TTL compatible external inputs.
A, A'; B, B'	Logic High or Low TTL level triggers detection.
C, D	Logic low TTL level triggers detection, internally strappable to High level.
FRONT PANEL INDICATORS	
Display	40-character plasma type display.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
FRONT PANEL INDICATORS (CON'T)	
Signal Status	Signal Loss, DS3 Frame Loss, Data Sync Loss, and Blue Signal Detected are indicated by individual LED's. A History LED indicates that one of these events has occurred during a test.
Test Status	Test in Process and Test Stopped indicators.
Time Modes	Untimed, Single, Repeat, and Single/Repeat indicators.
Input Signal Format	Frame, Pattern, and Level indicators.
Remote Control	IEEE-488 or RS-232C Remote Control indicator.
SIGNAL OUTPUTS	
Outputs	Frame errors, Bit Errors, Bipolar Violations, Recovered Clock, Parity Errors, DS3 M-Sync.
Level	TTL level into 75-ohm load.
Connectors	Rear-panel BNC.
STATUS OUTPUTS AND EVENT INPUTS	
Digital Status	Signal Loss, DS3 Frame Loss, Data Sync Loss, X-Bit Detected, Blue Signal Detected.
Level	TTL.
Impedance	1k-ohm source.
Analog Status	AGC, proportional to DS3 input level. VCO, control voltage of input clock recovery circuit. 3k-ohm source impedance.
Event Inputs	Four external inputs: A, B, C, D.
Level	TTL-compatible.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
STATUS OUTPUTS AND EVENT INPUTS (CON'T)	
Event Inputs (Con't)	
Trigger	A and B, positive and negative, C and D, logic low level, internally strappable to logic high.
Connector	Rear-panel 24-pin D type.
AUDIBLE ALARM	
General	Audible alarm can be programmed to respond to Error-Rate, Signal Loss, DS3 Frame Loss, or Blue Signal detected. Power-up condition responds to Bit, Parity, or BPV errors depending on total error display.
Tone	Proportional to the logarithm of the error rate or steady tone for Signal Loss, Frame Loss, and Blue Signal.
Volume	Set by front-panel control.
TIME MODES	
Untimed	Continuous accumulated measurements, and elapsed time.
Single	All measurements are accumulated for a programmable period from 1 second up to 100 days. At the end of test time, the test stops.
Repeat	All measurements are accumulated for a programmable period from 1 second to 100 days. At the end of the repeat time, the test automatically restarts.
Single/Repeat	A combination of single and repeat. The single duration time is longer than the repeat time.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
CLOCK	
Time-of-Day	23 hours, 59 minutes, 59 seconds. Internal battery powers clock for more than 2 months with power off. Front-panel setting.
Calendar	Day/Month/Year battery-backed calendar.
Test Times	Programmable from 1 second up to 100 days. Display of test times, elapsed time, time remaining.
DISPLAY	
Type	Dot matrix, Alphanumeric.
Size	40-character, 0.235 inch (0.6 cm) high.
POWER	
AC	115 VAC, 50 to 65 Hz, 100 VA maximum.
ENVIRONMENTAL	
Temperature	32°F to 104°F (0° to 40°C).
Humidity	0 to 95% relative humidity at 20°C (68°F), non-condensing.
MECHANICAL	
Dimensions	6.6 in. (16.8 cm) high x 13.6 in. (34.5 cm) x 19.8 in. (50.3 cm) deep.
Weight	21 lb. (9.5 kg) net.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
PRINTER OUTPUTS (with OP-02 or OP-03 only)	
Error-Second	User-selectable bit, frame, or parity printout for each second any error occurs. Includes number of errors in err-sec, data and time of err-sec, and status events (Signal Loss, Data Sync Loss, DS3 Frame Loss, Blue Signal Detected, and A, B, C, D External Events Detected).
Err-Sec Squelch	User-selectable automatic squelch of error-second printouts; err-sec printouts suppressed when 10 consecutive seconds of squelch condition are detected. Err-sec printouts re-enabled when the squelch condition is absent for 5 consecutive seconds. Squelch criterion is user-selectable. Options are: Squelch on any error-seconds, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} threshold error seconds or none. Printer outputs indicate the time of squelch and time that error-second prints are re-enabled.
End of Interval Summary	User-selectable automatic summary printout of parity and either frame or bit measurements at the end of time tests. Summary includes: Time-of-Day/Date, Summary type, Error type, Elapsed time, Receiver input set-up, Total errors, Average err rate, Total error-seconds, % Error-free seconds, Total Dribbling errors, Dribbling error-rate, Total 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} threshold error-seconds, Total status seconds.
Immediate Summary	Summary printout on demand of bit or parity measurements. Summary formatted like End of Interval Summary.
Power-Loss Summary	Upon restoration of power, a summary printout is printed which shows data collected until the power failure.
ACCESSORIES SUPPLIED	AC power cord, protective cover, instruction manual, and spare fuse.

TABLE A (CON'T)

S5200E RECEIVER SPECIFICATIONS

ITEM	DESCRIPTION
OPTIONS	
Option 02 IEEE-488 Interface: For remote control, front-panel LED indicates when receiver is under remote control.	
Option 03 RS-232C Interface: For remote control and/or output to printer, analog modem, or auxiliary channel. Printouts are made at the end of an error-second and at the end of a test. END OF ERROR SECOND: Real time at the end of the error-second, bit or parity errors accumulated during the error-second, and the event seconds for signal loss, frame loss, data-sync loss, blue-signal detected, and external A, B, C, and D inputs. END OF TEST: Duration of test, date and time-of-day at end of test, event seconds of all 9 internal and external events, total errors, total error seconds, average error rate, percent error-free seconds, total dribbling errors, dribbling error rate, and threshold bit and frame or parity error seconds.	
Option 06 Rackmount Kit: Adapts the S5200E for mounting in a standard 19-inch (48.3 cm) rack, 8.75 inch (22.2 cm) panel height. Includes front filler panel and support shelf for instrument.	
Option 09 Hard-Shell Shipping Case: Foam-lined fiberglass case.	
Option 10 Soft Carrying Case: Foam-lined canvas carrying case.	

SECTION 4

OPERATION

4. OPERATION

A. General

4.01 This section describes the use of all controls, connectors, and indicators of the S5200E DS3 Digital Transmission Test Set Receiver.

4.02 The S5200E Receiver front and rear panels are divided into sections of functionally related controls, indicators, and connectors. These sections are keyed by number in the front and rear panel illustrations of this section (see Figures 3 and 4). Use the number keys to locate information about a control, indicator, or connector in the table following the illustration (Tables B and C).

B. Power Connection and Power-Up Procedure

4.03 The correct procedure for making power connections and powering ON the S5200E Receiver is as follows:

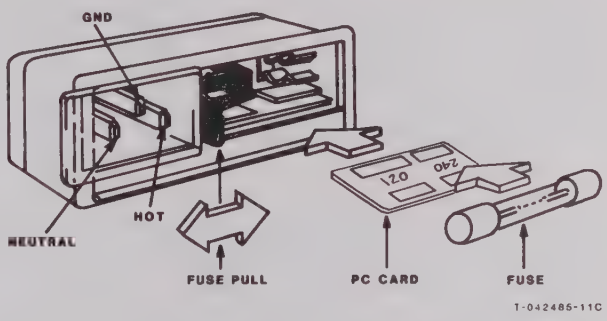


Fig. 2 - AC Power Connection and Fuse Housing

STEP	PROCEDURE
1	Check that the POWER Switch/Indicator is in the OFF position (In = ON, Out = OFF).
2	At the fuse housing on the rear panel, slide the plastic cover to the left to expose the fuse (see Fig. 2).
3	Push the FUSE PULL lever to the left, remove the fuse, and check to see that it is rated 2A slow-blow.
4	Check that the legend on the PC card in the fuse housing reads 120V. The 120V legend must be face-up and inserted as shown in Fig. 2. If this is not the case, remove the PC card (pull straight out), turn it around, and reinsert. The PC card is also marked for 240V, 100V, and 220V, but these ranges are not available for this unit.
5	Push the FUSE PULL lever to the right, back to its normal position, and reinstall the fuse.
6	Connect the 3-wire, AC power cord to the 3-prong connector of the S5200E Transmitter. Green = Ground, Black = Hot, White = Neutral.
7	Connect the male end of the AC power cord to a 115 VAC power source.
8	Push the POWER Switch/Indicator in, to the ON position. The Indicator should light, indicating that the unit is on.

C. Front Panel Controls, Indicators, and Connectors

4.04 The S5200E Receiver front panel (see Fig. 3) contains most of the controls and all of the indicators used to select or set the measurement parameters of signals input to the S5200E Receiver.

4.05 Table B explains the function of all the front panel controls, indicators, and connectors of the S5200E Receiver.

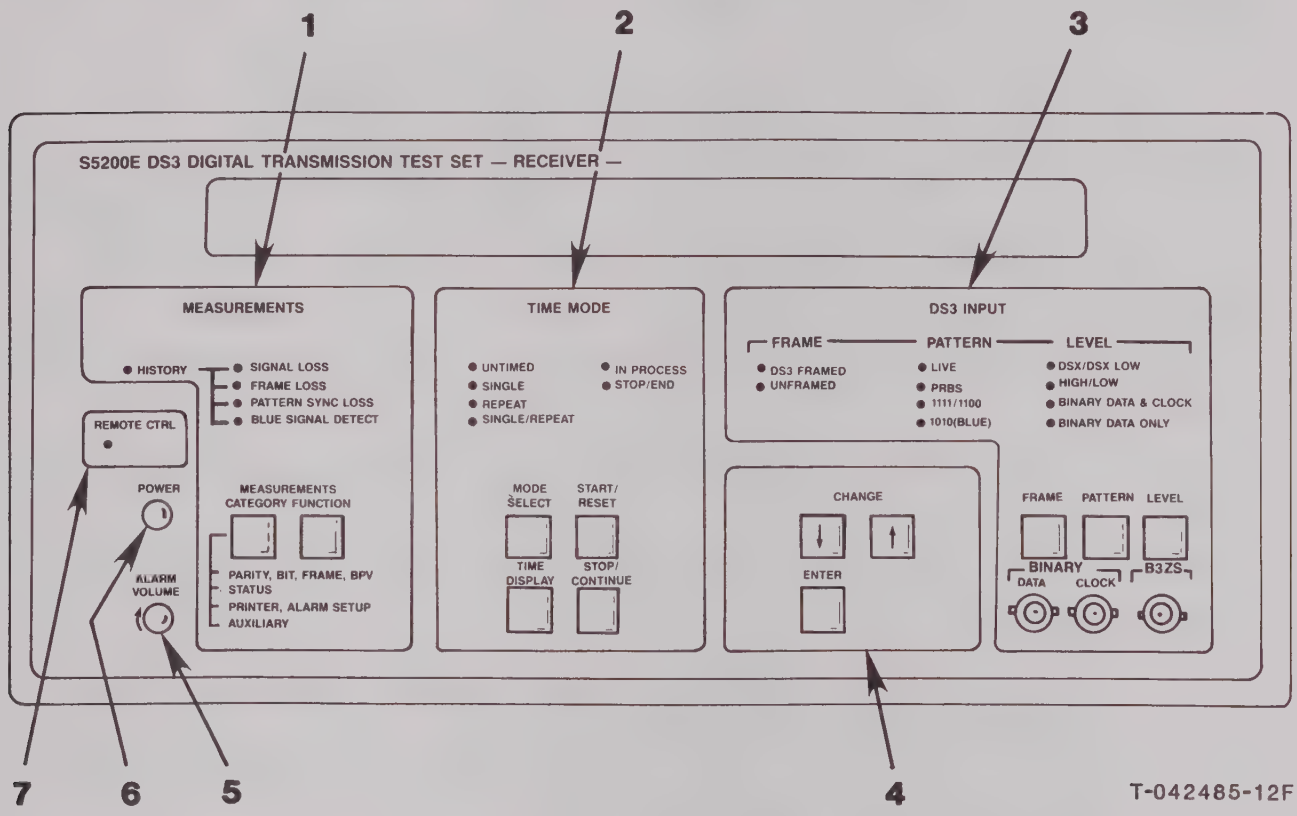


Fig. 3 - Front Panel Controls, Indicators and Connectors

TABLE B

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	MEASUREMENTS	This section contains the signal status indicators and pushbuttons used to select desired measurement categories and functions.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	SIGNAL LOSS (indicator)	Lights when the high-speed input hardware cannot adequately detect an incoming signal for the selected LEVEL. The SIGNAL LOSS indicator will remain ON while the SIGNAL LOSS condition is detected. When the condition is cleared, and signal regained, the SIGNAL LOSS indicator will go OFF.
	FRAME LOSS (indicator)	Lights when the input hardware cannot synchronize with the DS3 frame bits on the incoming signal. The FRAME LOSS indicator will remain ON while the FRAME LOSS condition is detected. When the condition is cleared, and DS3 frame regained, the FRAME LOSS indicator will go OFF. The FRAME LOSS indicator is not functional and will not light when the Receiver is in the UNFRAMED mode.
	PATTERN SYNC LOSS (indicator)	Lights when the input hardware cannot synchronize with the incoming data pattern. The PATTERN SYNC LOSS indicator will remain ON while the PATTERN SYNC LOSS condition is detected. When pattern synchronization is regained, the PATTERN SYNC LOSS indicator will go OFF. Since the data pattern is unknown for LIVE traffic, the PATTERN SYNC LOSS is not functional and will not light when the Receiver is in the LIVE mode.
	BLUE SIGNAL DETECT (indicator)	Lights when the high-speed hardware detects a repeating 1010 data pattern in a DS3 FRAMED signal, the blue signal. The BLUE SIGNAL DETECT indicator will remain ON while a blue signal is detected. When the condition is cleared, and blue signal not detected, the BLUE SIGNAL DETECT indicator will go OFF. If the received input signal is unframed, the BLUE SIGNAL DETECT indicator is not functional and will not light.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	MEASUREMENTS CATEGORY (push-button)	Selects one of the following measurement or instrument setup categories, stepping through the selections in the order shown: • PARITY error measurement • BIT error measurement • FRAME error measurement • BPV error measurement • STATUS second measurements • PRINTER setup • Audio ALARM Setup • AUXILIARY function setup. If the CATEGORY (or FUNCTION) pushbutton is not currently controlling the display, the first time the CATEGORY pushbutton is pressed the display will prompt: "Press FUNCTION to select xxxxxxxxxxxxxxx" where xxxxxxxxxxxxxxx is the flashing prompt for the most recently selected CATEGORY. The possible prompts are: • PARITY ERR MEAS • BIT ERR MEAS • FRAME ERR MEAS • BPV ERR MEAS • STATUS SEC MEAS • PRINTER SETUP • ALARM SETUP • AUXILIARY SETUP.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	MEASUREMENTS CATEGORY (push-button) (con't)	The CATEGORY or CHANGE pushbuttons are used to step through the available categories. The FUNCTION or ENTER pushbuttons are then used to select the flashing category.
	MEASUREMENTS FUNCTION (pushbutton)	Selects the FUNCTION for the selected CATEGORY. Pressing the FUNCTION pushbutton will scroll through the available functions for the selected measurement category. In addition, pressing the appropriate CHANGE pushbutton will scroll forward or backward through the available functions of the selected measurement category. The table below summarizes the functions and their formats available for each measurement category. Following this table, the Measurement Displays and the Printer Output, Audio Alarm, and Auxiliary functions are explained in more detail.
	CATEGORY	FUNCTION DISPLAYS
	PARITY ERR MEAS	PAR ErrRate Now=1.2E-08, TotalEr=123456789 PAR AvgErrRate=1.2E-16, Elap=99-23:59:59 PAR AvgErrRate=1.2E-16, DribRate=1.2E-16 PAR %ErFreeSec=100.000, Elap=99-23:59:59 PAR ErrorSec=1234567, TotalEr=123456789 PAR ThreshErrSec E-6=1234567, E-5=1234567 PAR ThreshErrSec E-4=1234567, E-3=INVALID PAR DribTotal=12345678, TotalEr=123456789
	BIT ERR MEAS	BIT ErrRate Now=1.2E-08, Total Er=123456789 BIT AvgErrRate=1.2E-16, Elap=99-23:59:59 BIT AvgErrRate=1.2E-16, DribRate=1.2E-16 BIT %ErFreeSec=100.000, Elap=99-23:59:59 BIT ErrorSec=1234567, TotalEr=123456789 BIT ThreshErrSec E-6=1234567, E-5=1234567 BIT ThreshErrSec E-4=1234567, E-3-1234567 BIT DribTotal=12345678, TotalEr=123456789

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
	CATEGORY	FUNCTION DISPLAYS
1	FRAME ERR MEAS	FRM ErrRate Now=INVALID, TotalEr=123456789 FRM AvgErrRate=1.2E-16, Elap=99-23:59:59 FRM AvgErrRate=1.2E-16, DribRate=INVALID FRM %ErFreeSec=100.000, Elap=99-23:59:59 FRM ErrorSec=1234567, TotalEr=123456789 FRM ThreshErrSec E-6=INVALID, E-5=1234567 FRM ThreshErrSec E-4=1234567, E-3=1234567 FRM DribTotal=INVALID, TotalEr=INVALID
	BPV ERR MEAS	BPV ErrRate Now=1.2E-0.8, TotalEr=123456789 BPV AvgErrRate=1.2E-16, Elap=99-23:59:59 BPV %ErrFreeSec=99.9996, Elap=99-23:59:59 BPV Error Sec=1234567, TotalEr=123456789
	STATUS SECOND MEAS	Signal Loss Sec =1234567, Elap =99-23:59:59 Frame Loss Sec =1234567, Elap =99-23:59:59 Sync Loss Sec =1234567, Elap =99-23:59:59 Blue Signal Sec =1234567, Elap =99-23:59:59 X-bit =1234567, Elap =99-23:59:59 External A Sec =1234567, Elap =99-23:59:59 External B Sec =1234567, Elap =99-23:59:59 External C Sec =1234567, Elap =99-23:59:59 External D Sec =1234567, Elap =99-23:59:59 Press ENTER to clear status history LED Pwr Loss 01 Jan 12:54:35 to 18 Mar 23:59:59 No power loss recorded.
	PRINTER	Press ENTER for Immediate Summary. Press ENTER for End-Interval Summary. Current Selection = PARITY ErrSec Printout Current Selection = BIT ErrSec Printout Current Selection = FRAME ErrSec Printout Current Selection = BPV ErrSec Printout Current Selection = NO ErrSec Printout Current Selection = No squelch on ErrSec Current Selection = Squelch on E-6 ErrSec Current Selection = Squelch on E-5 ErrSec Current Selection = Squelch on E-4 ErrSec Current Selection = Squelch on E-3 ErrSec Current Selection = Squelch on ANY ErrSec

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
	CATEGORY	FUNCTION DISPLAYS
1	AUDIO ALARM	Current Selection = Signal Loss Alarm Current Selection = Frame Loss Alarm Current Selection = Sync Loss Alarm Current Selection = Blue Signal Alarm Current Selection = Error Rate Alarm
	AUXILIARY	Press ENTER to set Date and Time-of-day. Press ENTER for "Do not disturb" message.
	Parity Error Displays	When the PARITY category is selected, the parity error measurement last displayed will be shown. Subsequent pressing of the FUNCTION pushbutton will scroll through the available parity error displays. Also, the CHANGE pushbuttons can be used to scroll forward or backward through the available parity error displays. If the UNFRAMED mode is selected and then PARITY error measurements are selected, the display will show: "PARITY meas. Invalid for UNFRAMED signal."
	Bit Error Displays	When the BIT category is selected, the bit error measurement last displayed will be shown. Subsequent pressing of the FUNCTION pushbutton will scroll through the available bit error displays. Also, the CHANGE pushbuttons can be used to scroll forward or backward through the available bit error displays. If LIVE pattern data is being monitored and BIT error measurements are selected, the display will show: "BIT meas. Invalid for LIVE signal."

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	Frame Error Displays	When the FRAME category is selected, the frame error measurement last displayed will be shown. Subsequent pressing of the FUNCTION pushbutton will scroll through the available frame error displays. Also, the CHANGE pushbuttons can be used to scroll forward or backward through the available frame error displays. Due to the low frequency of frame bits (28 f-bits per 4,760 bits in a superframe), current error rate, E-6 threshold error second, dribbling total, and dribbling error rate measurements are all invalid for frame error measurements. If UNFRAMED input is currently being monitored and FRAME error measurements are selected, the display will show: "FRAME meas. Invalid when UNFRAMED." If the PRBS, 1100, 1111, or 1010 pattern is currently selected and FRAME error measurements are selected, the display will show: "FRAME meas. Invalid for xxxx pattern," where xxxx is the current pattern selection.
	BPV Error Displays	When the BPV category is selected, the BPV error measurement last displayed will be shown. Subsequent pressing of the FUNCTION pushbutton will scroll through the available BPV error measurement displays. Also, the CHANGE pushbuttons can be used to scroll forward or backward through the BPV error measurement displays. If the BINARY DATA & CLOCK or BINARY DATA ONLY level is currenly being input and BPV error measurements are selected, the display will show: "BPV measurement invalid for BINARY level."

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	Status Seconds Displays	When the STATUS category is selected, the status seconds measurement last displayed will be shown. Subsequent pressing of the FUNCTION pushbutton will scroll through the available status seconds displays. Also, the CHANGE pushbuttons can be used to scroll forward or backward through the status seconds displays. When status conditions are invalid, the totals field of the display will read "Invalid." The signal status HISTORY LED may be cleared by pressing the ENTER pushbutton when the HISTORY LED reset prompt is displayed.
	Printer Output Selection	When the PRINTER category is selected, the FUNCTION, CHANGE, and ENTER pushbuttons are used to review or modify the current printer setup. The IMMEDIATE SUMMARY selection prompt is always displayed first when the PRINTER category is selected. The FUNCTION pushbutton is used to scroll through the available printer function displays. For each function selection, the CHANGE and ENTER pushbuttons are used to modify and select the printer function.
	Immediate Summary Display	When the Immediate Summary printer function prompt is selected and the ENTER pushbutton is pressed, an Immediate Summary is generated and the display returns to the Printer category prompt. The CHANGE pushbuttons are ignored when the Immediate Summary prompt is displayed. See subsection D. Printer Outputs for complete information about Immediate Summary printouts.
	End-Of-Interval Summary Display	When the End-Of-Interval Summary prompt is selected and displayed, the CHANGE or ENTER pushbuttons can be used to enable or disable End-of-Interval Summary printouts. If the FUNCTION or ENTER pushbutton is pressed, the Error Second printout prompt will be displayed with the current selection flashing.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	End-of-Interval Summary Displays (con't)	See subsection D. Printer Outputs for complete information about End-Of-Interval Summary printouts.
	Error-Second Printout Displays	When the Error-Second printout display is first shown, the currently selected Error-Second printout prompt will be displayed. The CHANGE pushbuttons can be used to scroll through the available Error-Second printout options. The display will show "Press ENTER for" when options other than the currently selected one are displayed. Pressing the ENTER pushbutton selects the displayed option. If no Error-Second printout is selected, the display returns to the Printer category prompt. If Error-Second printouts are selected, the display will go on to the Error Second Squelch prompts. See subsection D. Printer Outputs for complete information about Error-Second printouts.
	Error-Second Squelch Printout Displays	If Error-Second printouts are enabled, pressing the FUNCTION or ENTER pushbutton causes the Error-Second Squelch prompt to be displayed with the current squelch criterion flashing. The CHANGE or ENTER pushbuttons can be used to modify or select the squelching criteria. When the ENTER pushbutton is pressed, the display returns to the Printer category prompt. See subsection D. Printer Outputs for complete information about Error-Second Printout Squelching.
	Audible Alarm Displays	When the ALARM category is selected, the display shows the currently selected alarm type with the prompt "Current Selection =" followed by the alarm type (Error Rate, Signal Loss, Frame Loss, Sync Loss, or Blue Signal), which will be flashing. The FUNCTION or

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	Audible Alarm Displays (con't)	CHANGE pushbuttons can be used to scroll through the other available alarm type displays. When an alarm type other than the current selection is displayed, it will be accompanied by the display "Press ENTER for." Pressing the ENTER pushbutton selects the currently displayed alarm type and returns the display to the ALARM category prompt.
	Auxiliary Function	When the AUXILIARY category is selected, the most recently selected AUXILIARY function is displayed. The FUNCTION or CHANGE pushbuttons are used to scroll through the other available auxiliary functions. When the display reads: "Press ENTER for "Do not disturb" message," pressing the ENTER pushbutton will cause the display to show: <<Test in process. Please do not disturb!!>>. When the display reads: "Press ENTER to set Date and Time-Day," pressing the ENTER pushbutton will cause the display to show the following format: "Date=28 Jan, 1985 Time = 13:05:00", with the tens-of-days units flashing. At this time, the tens-of-days units can be edited by using the CHANGE pushbuttons to select a new number. When the desired number is displayed, press the ENTER pushbutton. Next, the single units for days will flash and can be edited in the same manner as the tens-of-days units. This procedure is repeated until the time-of-day minutes are entered. Seconds cannot be set and are set to zero when the minutes are entered. The display returns to the AUXILIARY category prompt after the minutes are entered.
2	TIME MODE	This section contains the TIME MODE and test status indicators and the pushbuttons to select and display time modes or start and stop tests.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
2	MODE SELECT	Selects one of four available test time modes: UNTIMED, SINGLE, REPEAT, or SINGLE/REPEAT, lighting the appropriate indicator. When the SINGLE, REPEAT, or SINGLE/REPEAT mode is selected, the user is prompted to enter the SINGLE or REPEAT test time interval. If a test is IN PROCESS and the MODE SELECT pushbutton is pressed, the test will STOP. The display will immediately show one of the following prompts: MODE — PROMPT UNTIMED — Press START/RESET for UNTIMED testing. SINGLE — SINGLE INTERVAL DD-HH:MM:SS=dd-hh:mm:ss REPEAT — REPEAT INTERVAL DD-HH:MM:SS=dd-hh:mm:ss SINGLE/REPEAT — SINGLE INTERVAL DD-HH:MM:SS=dd-hh:mm:ss NOTES: 1. For the UNTIMED mode, the words START/RESET flash. 2. For the SINGLE, REPEAT, and SINGLE/REPEAT modes, the tens-of-days position will flash. dd-hh:mm:ss is the current SINGLE or REPEAT interval. When the UNTIMED mode prompt is displayed, pressing either the START/RESET or ENTER pushbutton will cause an UNTIMED test to begin and the display to return to the most recently selected CATEGORY and FUNCTION.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
2	MODE SELECT (con't)	When the SINGLE or REPEAT mode is displayed, pressing the START/RESET pushbutton will cause the timed mode testing to begin for the currently displayed time interval and the display to return to the most recently selected CATEGORY and FUNCTION. Also, when the SINGLE or REPEAT mode prompt is displayed, the flashing digit of the time interval can be increased or decreased using the CHANGE pushbuttons or saved by pressing the ENTER pushbutton. When a digit is ENTERed, it will stop flashing and the next digit to the right will start flashing. After units of seconds is ENTERed, the edit is complete and the test is started. If the SINGLE/REPEAT mode is selected and single interval seconds are ENTERed, the REPEAT interval will be displayed with the tens-of-days digit flashing. When a TIME MODE prompt is already displayed, pressing the MODE SELECT pushbutton causes the mode to scroll to the next mode selection, displaying the appropriate mode prompt.
	UNTIMED (indicator)	Lights when the UNTIMED test mode is selected. In this mode, measurements and elapsed time accumulate until a test is stopped or reset. See MODE SELECT (pushbutton).
	SINGLE (indicator)	Lights when the SINGLE mode is selected. In this mode, test measurements accumulate until a programmed time interval elapses (1 second to 1 second less than 100 days) or until the test is stopped or reset. See MODE SELECT (pushbutton) and TIME DISPLAY (pushbutton).
	REPEAT (indicator)	Lights when the REPEAT mode is selected. In this mode, test measurements accumulate until the programmed REPEAT interval elapses (1 second to 1 second less than 100 days) or

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
2	REPEAT (indicator) (con't)	until the test is stopped or reset. At the end of the interval, data is stored and displayed and a new test starts to run for the same interval. The information displayed is from the most recently completed test. See MODE SELECT (pushbutton) and TIME DISPLAY (pushbutton).
	SINGLE/REPEAT (indicator)	Lights when the SINGLE/REPEAT mode is selected. In this mode, test measurements accumulate until the programmed REPEAT time interval elapses (1 second to 1 second less than 100 days) or until the test is stopped or reset. At the end of the REPEAT time interval, data is stored and displayed and a new test starts to run for the same time interval. The SINGLE interval is the total time the REPEAT tests are set to run. Therefore, the SINGLE interval must always be longer than the REPEAT time interval. See MODE SELECT (pushbutton) and TIME DISPLAY (pushbutton).
	TIME DISPLAY (pushbutton)	Enables the user to view the time-of-day/date and current test times. If time is not currently displayed, the first time the TIME DISPLAY pushbutton is pressed, it selects the most recently shown time display. When the Receiver is set to the UNTIMED test mode, the TIME DISPLAY pushbutton can be used to view the time-of-day or the elapsed test time. The UNTIMED mode elapsed time is displayed in the form: Elapsed Time (DD-HH:MM:SS) = dd-hh:mm:ss, where dd-hh:mm:ss is the current elapsed test time. Time-of-day/date is displayed in the form: Date = dd mmm, 19yy, Time = hh:mm:ss,

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
2	TIME DISPLAY (pushbutton) (con't)	where: dd is the current day of the month (1-31), mmm is the three-letter abbreviation for the current month, yy is the current year, hh is the current hour of the day (0-23), mm is the current minutes (0-59), ss is the current seconds (0-59). The TIME DISPLAY pushbutton can be used to view: time-of-day/date, elapsed time, interval (SINGLE, REPEAT and SINGLE/REPEAT), or time remaining (SINGLE, REPEAT and SINGLE/REPEAT). These times are displayed in the following order and format: Date = dd-mmm-yy, Time = hh:mm:ss Elapsed Time (DD-HH:MM:SS) = dd-hh:mm:ss (UNTIMED only) Single Elapsed = dd-hh:mm:ss Single Remaining = dd-hh:mm:ss Single Interval = dd-hh:mm:ss Repeat Elapsed = dd-hh:mm:ss Repeat Remaining = dd-hh:mm:ss Repeat Interval = dd-hh:mm:ss
	START/RESET (pushbutton)	Pressing the START/RESET pushbutton starts a new test and accomplishes the following: • Resets the HISTORY status indicator • Clears all error accumulators

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
2	START/RESET (pushbutton) (con't)	• Resets the elapsed time to 0. When the new test starts, the IN PROCESS indicator lights. No other controls are affected when testing is STARTed or RESET.
	IN PROCESS (indicator)	Lights when a test is currently running (in process).
	STOP/CONTINUE (pushbutton)	Pressing the STOP/CONTINUE pushbutton when a test is in process causes the test to STOP. At this time, the IN PROCESS indicator will go OFF and the STOP/END indicator will flash. If a test has been STOPped, pressing the STOP/CONTINUE pushbutton causes the test to CONTINUE from where it was last stopped. Nothing is reset. At this time, the STOP/END indicator will stop flashing and then the IN PROCESS indicator lights.
	STOP/END (indicator)	Flashes when a test has been STOPped by the STOP/CONTINUE pushbutton or has completed its programmed interval.
3	DS3 INPUT	This section contains the pushbuttons and indicators used to set the measurement parameters for testing DS3 signals input to the Receiver. Also, this section contains BINARY DATA and CLOCK BNC connectors and a bipolar B3ZS connector.
	FRAME (pushbutton)	Selects the expected input framing; either FRAMED or UNFRAMED. When the FRAME pushbutton is pressed, an IN PROCESS test will be restarted. If the current PATTERN selection is LIVE traffic and the UNFRAMED input is selected, the display will flash: LIVE data invalid with UNFRAMED signal!!!

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
3	FRAME (pushbutton) (con't)	NOTE: When this message is displayed, the Receiver will ignore all pushbuttons other than the FRAME and PATTERN pushbuttons.
	DS3 FRAMED (indicator)	Lights when DS3 FRAMED input is selected by the FRAME pushbutton.
	UNFRAMED (indicator)	Lights when UNFRAMED input is selected by the FRAME pushbutton.
	PATTERN (pushbutton)	Selects, in conjunction with the rear panel SHORT PATTERNS switch, the expected pattern of the data bits in the incoming DS3 signal stream. The available pattern selections are: LIVE, PRBS, 1111, 1100, and 1010. The PATTERN pushbutton is used to scroll through the available pattern selections. The rear panel SHORT PATTERN switch selects which of the three short patterns (1111, 1100, or 1010) is expected. Pressing the PATTERN pushbutton or switching the rear panel SHORT PATTERN switch causes an IN PROCESS test to restart. If the Receiver is in the UNFRAMED mode and the LIVE pattern is selected, the display will flash: LIVE data invalid with UNFRAMED signal!!!
	LIVE (indicator)	Lights when DS3 LIVE traffic is selected as the input data pattern. See PATTERN (pushbutton).
	PRBS (indicator)	Lights when the PRBS, pseudorandom bit sequence, input data pattern is selected. See PATTERN (pushbutton).
	1111/1100 (indicator)	Lights when the 1111 or 1100 input data pattern is selected. The pattern selected, either 1111 or 1100, is determined by the rear panel SHORT PATTERNS switch. See PATTERN (pushbutton) and Table C - SHORT PATTERN (toggle switch).

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
3	1010 (BLUE) (indicator)	Lights when the 1010 input data pattern is selected. If the 1010 pattern is framed, it is referred to as the BLUE pattern. The rear panel SHORT PATTERN toggle switch is used to select the 1010 (BLUE) short pattern; in addition to the PATTERN pushbutton. See PATTERN (pushbutton) and Table C - SHORT PATTERN (toggle switch).
	LEVEL (pushbutton)	Selects the expected input signal level, lighting the appropriate indicator for one of the four available selections: DSX/DSX LOW, HIGH/ LOW, BINARY DATA & CLOCK, and BINARY DATA ONLY. Pressing the LEVEL pushbutton when a test is IN PROCESS will restart the test.
	DSX/DSX LOW (indicator)	Lights when the DSX/DSX LOW level input is selected. The DSX level is a bipolar level and waveform defined by AT&T Technical Advisory No. 34, which typically is the HIGH level passed through 450 feet (137 meters) of 728A coaxial cable. The DSX LOW level is typically the DSX level passed through another 450 feet (114 meters) of 728A coaxial cable.
	HIGH/LOW (indicator)	Lights when the HIGH/LOW level input is selected. The HIGH level is undisturbed bipolar pulses of .9 to 1.8 volts peak. The LOW level is a waveform similar to that of the HIGH level but the level is attenuated 13.8 dB below the HIGH level.
	BINARY DATA & CLOCK (indicator)	Lights when the BINARY DATA & CLOCK level input is selected. The BINARY DATA & CLOCK level input is a Non-Return to Zero (NRZ) signal with external timing applied to the data signal. The level should exceed ±.5 volts peak-to-peak.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
3	BINARY DATA ONLY (indicator)	Lights when the BINARY DATA ONLY input level is selected. The BINARY DATA ONLY input is an NRZ signal without external timing applied. The timing recovery is performed internally by the Receiver. Therefore, input patterns must have sufficient activity to permit timing recovery. This excludes the 1111 pattern from being used. The level should exceed ±.5 volts peak-to-peak.
	BINARY DATA (connector)	BNC connector used to input NRZ data signals. Accepts 75 ohms impedance. Input should be ±.5 volts peak-to-peak minimum and is DC coupled (internally strappable to AC coupled). The normal threshold is 0 volts, internally strappable to ECL or TTL thresholds.
	BINARY CLOCK (connector)	BNC connector used to input an external clock signal. The signal is a squarewave with a frequency range of 44.736 MHz ±3.0 MHz. The rising clock edge is in the center of the data bits ±4 ns. Normal threshold is 0 volts, internally strappable to ECL or TTL thresholds. Accepts 75 ohms impedance.
	B3ZS (connector)	Accepts WECo 358 type plugs. Used to input Bipolar with 3 Zero Substitution (B3ZS) coded signals with a frequency range of 44.736 MHz ±1.5 MHz. Impedance is 75 ohms with greater than 20 dB return loss from 1 to 50 Mhz.
4	CHANGE (pushbuttons)	The CHANGE pushbuttons are used to edit numerous measurement and time settings. There are two pushbuttons, an "up" (↑) and a "down" (↓) pushbutton. They are used to increase or decrease values and to scroll forward or backward through available selections shown on the display.
	ENTER (pushbutton)	Selects a prompt or edited value shown on the display.

TABLE B (CON'T)

FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
5	ALARM VOLUME (control)	Sets the volume of the audio alarm. See Audible Alarm Displays.
6	POWER (switch/indicator)	Powers-up the Receiver. When pressed in, the indicator lights, showing that the Receiver is ON.
7	REMOTE CTRL (indicator)	Lights when the Receiver is under remote control. If the Receiver is not configured with the IEEE-488 GPIB or the RS-232C Interface option, the REMOTE CTRL indicator will not be functional. See subsection E, Remote Control. Also, see Appendix A IEEE-488 GPIB INTERFACE and Appendix B RS-232C INTERFACE.

D. Rear Panel Controls and Connectors

4.06 The S5200E Receiver rear panel (see Fig. 4) contains:

- ERROR, CLOCK, and M SYNC BNC connectors
- The SHORT PATTERNS toggle switch
- A 24-pin D-type MONITOR connector
- Optional RS-232C and/or GPIB interfaces.

4.07 Table C explains the function of all the rear panel controls, connectors, and interfaces of the S5200E Receiver.

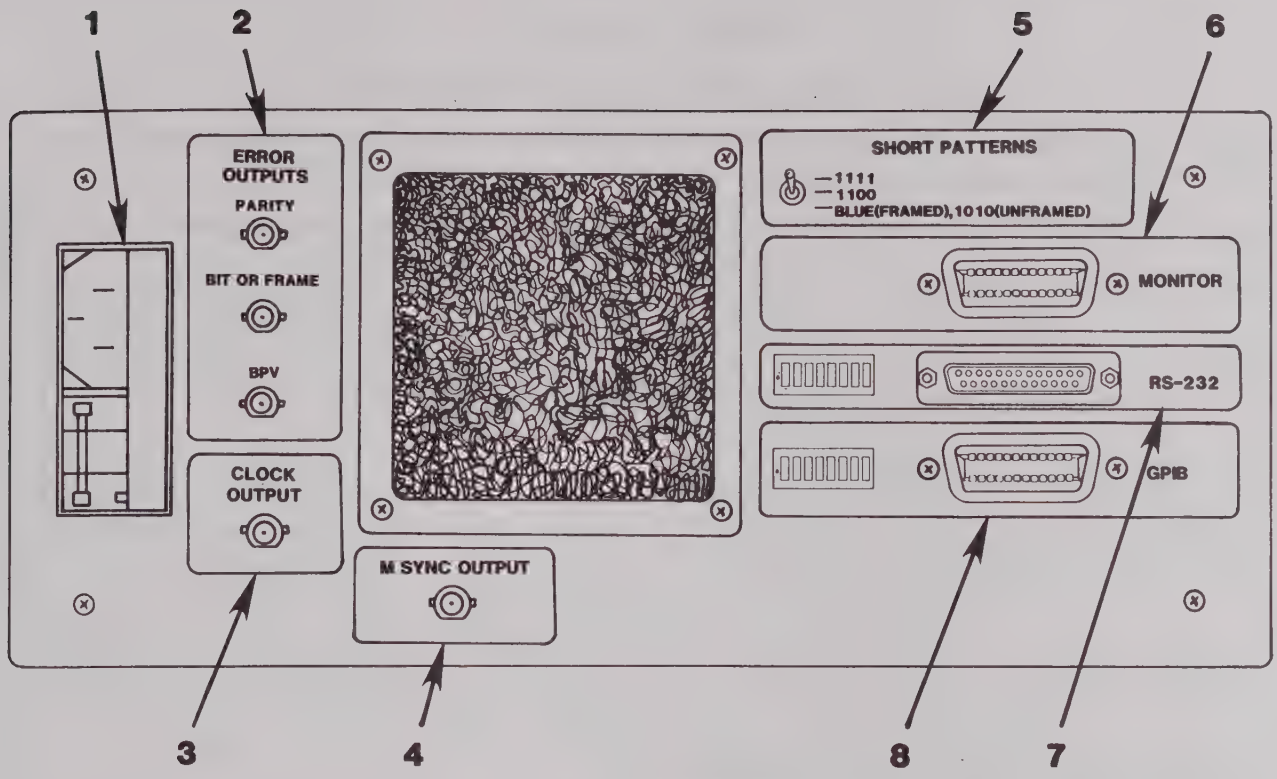


Fig. 4 - Rear Panel Controls and Connectors

TABLE C

REAR PANEL CONTROLS AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	AC Power Connector/ Fuse Housing	Contains the 3-prong AC power connector and fuse. For complete and detailed information, see section 4C, Power Connection and Power-Up Procedure.
2	ERROR OUTPUTS	These connectors output errors for monitoring. The type of errors output is indicated above the connector.
	PARITY (connector)	BNC connector capable of driving 75 ohms. TTL compatible level. The pulse width is 300 ns ± 50 ns with one pulse detected per parity error.

TABLE C (CON'T)

REAR PANEL CONTROLS AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
2	BIT OR FRAME (connector)	BNC connector capable of driving 75 ohms. The level is ± 0.5 volts. The pulse width is positive true 11 ns ± 3 ns with one pulse detected per bit or frame error.
	BPV (connector)	BNC connector capable of driving 75 ohms. The level is ± 0.5 volts and the pulse width is positive true 11 ns ± 3 ns. Normal bipolar data have consecutive 1's that alternate in polarity. When two consecutive 1's have the same polarity and do not conform to the B3ZS coding, the second is considered a bipolar pulse violation.
3	CLOCK OUTPUT (connector)	BNC connector capable of driving 75 ohms. The signal is a squarewave with a level of ± 0.5 volts. The frequency follows the input clock rate and is normally 44.736 MHz.
4	M SYNC OUTPUT (connector)	BNC connector capable of driving 75 ohms. The level is TTL compatible. The pulse width is 15.2 µs ± 200 ns and occurs once per DS3 Master Frame.
5	SHORT PATTERNS (toggle switch)	Selects the short data pattern (1111, 1100, or 1010) to be input to the Receiver. The short pattern selected by the SHORT PATTERNS toggle switch is used by the front panel DS3 INPUT PATTERN pushbutton to light the appropriate indicator when short patterns are selected for input to the Receiver. See Table B - PATTERN (pushbutton).

TABLE C (CON'T)

REAR PANEL CONTROLS AND CONNECTORS

<table>
<tr><th>NO.</th><th>DESIGNATION</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td>6</td><td>MONITOR (connector)</td><td colspan="2">A 24-pin D-type monitor connector used for external monitoring.

There are six TTL compatible status outputs with a source impedance of 1000 ohms to +5 volts. The output driver is a TTL driver 7407. There are two additional outputs: an Automatic Gain Control and a Voltage Control Oscillator output. The following table explains these outputs and gives their corresponding pin numbers.</td></tr>
<tr><td></td><td></td><td>PIN</td><td>FUNCTION</td></tr>
<tr><td></td><td></td><td>2</td><td>X-Bit - Occurs once per DS3 Master Frame and is active low.</td></tr>
<tr><td></td><td></td><td>3</td><td>Sync Loss - 2^{15}-1 sequence generator in sync signal and is active low (out of sync).</td></tr>
<tr><td></td><td></td><td>4</td><td>Signal Loss - Indicates loss of the input signal and is active low (no input).</td></tr>
<tr><td></td><td></td><td>14</td><td>Frame Loss - The DS3 Master Frame signal and is active low (loss of frame).</td></tr>
<tr><td></td><td></td><td>15</td><td>Blue Signal - A 1010 signal with DS3 frame bits and is active low (blue signal detect).</td></tr>
<tr><td></td><td></td><td>13</td><td>PR Sync - A 15 µs pulse that occurs once per 2^{15}-1 sequence.</td></tr>
<tr><td></td><td></td><td>8</td><td>AGC (Automatic Gain Control) - 3.6k ohm source impedance. A DC voltage that indicates the level of the B3ZS DS3 input signal.</td></tr>
</table>

TABLE C (CON'T)

REAR PANEL CONTROLS AND CONNECTORS

<table>
<tr><th>NO.</th><th>DESIGNATION</th><th>DESCRIPTION</th></tr>
<tr><td rowspan="6">6</td><td rowspan="6">MONITOR (connector)
(con't)</td><td>PIN FUNCTION</td></tr>
<tr><td>9 VCO (Voltage Control Oscillator) - 3.6k ohm source impedance. A DC voltage which indicates that the VCO is locked into the incoming data rate at the B3ZS DS3 input.</td></tr>
<tr><td>There are four compatible inputs with a termination impedance of 1.5k ohms. These inputs can be used for external alarms such as multiplexer, open door, AC generator alarm, etc. The following table explains these inputs and gives the corresponding pin numbers.</td></tr>
<tr><td>PIN FUNCTION</td></tr>
<tr><td>16 Event-A Active High.
5 Event-A' Same input as Event-A; except Active Low.
17 Event-B Active High.
6 Event-B' Same input as Event-B; except Active Low.
18 Event-C Active Low.
7 Event-D Active Low.
NOTE: Event-C and Event-D are set at the factory to be active low and may be set for active high by jumping E7 to E5 (Event-C) and by jumping E8 to E10 (Event-D) on the Status and Control plug-in printed circuit board.</td></tr>
</table>

TABLE C (CON'T)

REAR PANEL CONTROLS AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
6	MONITOR (connector) (con't)	PIN FUNCTION 1 Circuit Ground 11 Circuit Ground 12 Circuit Ground 23 Circuit Ground 24 Circuit Ground
7	RS-232C (Interface/ connector)	An optional RS-232C interface consisting of a 25-pin D-connector and a DIP switch. See Appendix B - RS-232C INTERFACE for complete and detailed information.
8	GPIB (Interface/ connector)	An optional IEEE-488 interface consisting of a 24-pin D-connector and a DIP switch. See Appendix A - IEEE-488 GPIB INTERFACE for complete and detailed information.

E. Printer Outputs

4.08 If the S5200E Receiver is configured with the optional GPIB or the RS-232C interface, it has the capability to provide user-selectable automatic Printer Outputs. Printouts are 40 characters per line plus a carriage return and a line feed.

4.09 There are three types of summary printouts: End-Of-Interval Summary Printout, Immediate Summary Printout, and Power Loss Summary Printout.

End-Of-Interval Printout

4.10 All Bit (or Frame) and Parity measurements are summarized at the end of a Single or Repeat test interval. If an End-Of-Interval Summary Printout is enabled (see Table B - Printer Output Selection), it is formatted and automatically output to the Printer interfaces. Figure 5 is an example of an End-Of-Interval Summary Printout. The printout contains the following information:

- Time-of-Day/Date when the summary was formatted

- Indication of Summary Type (END-OF-INTERVAL, IMMEDIATE, or POWER LOSS)
- Elapsed Test Time
- Receiver Input Setup

  FRAMED or UNFRAMED

  PATTERN (LIVE, PRBS, 1111, 1100, or 1010)

  LEVEL (DSX/DSX LOW, HIGH/LOW, BINARY & CLOCK, or BINARY ONLY).
- Bit and Parity or Frame and Parity:

  Total Errors

  Total Error Seconds

  Average Error Rate

  % Error Free Seconds.
- Total Dribbling Errors (Bit and Parity only)
- Dribbling Error Rate (Bit and Parity only)
- Threshold Error Seconds for 10^{-6}, 10^{-5}, 10^{-4}, or 10^{-3} (10^{-6} is Invalid for Frame; 10^{-3} is Invalid for Parity)
- Status Seconds for Signal Loss, Frame Loss, Sync Loss, Blue Signal Detected, X-Bit Detected
- Event Seconds for External A, B, C, and D events.

Immediate Summary Printout

4.11 If an Immediate Summary Printout is enabled by the front panel controls (or remote control), an Immediate Summary Printout will be generated. The current data at the time an Immediate Summary is selected will be printed. The format and contents of the Immediate Summary Printout are the same as the End-Of-Interval Summary Printout (see the preceding paragraph). Figure 6 shows an example of an Immediate Summary Printout.

```
07Jan 13:56:58   END-OF-INTERVAL SUMMARY
Elapsed Time=00-00:00:10  (10      Secs)
SIGNAL=  Framed,Live Traffic,DSX/DSX low
*FRAME ERROR SUMMARY:
  TotalErr=1          Avg ErrRate=3.8E-07
  ErrorSec=1          %ErrFreeSec=90.0000
  FRAME THRESHOLD ERROR SECONDS:
   E-6 Sec=INVALID    E-5 Sec=0
   E-4 Sec=0          E-3 Sec=0
*PARITY ERROR SUMMARY:
  TotalErr=5          Avg ErrRate=1.1E-08
  ErrorSec=5          %ErrFreeSec=50.0000
  Drib Err=5          DribErrRate=1.1E-08
  PARITY THRESHOLD ERROR SECONDS:
   E-6 Sec=0          E-5 Sec=0
   E-4 Sec=0          E-3 Sec=INVALID
*STATUS AND EVENT SECONDS:
SigLos=0          A=0          B=0
  Sync=INVALID    C=0          D=0
 Frame=0       Blue=0       Xbit=0
```

NOTE: PRINTOUT SHOWN AT 70% OF ACTUAL SIZE

Fig. 5 - End-Of-Interval Summary Printout

```
07Jan 13:55:30      IMMEDIATE    SUMMARY
Elapsed Time=00-00:00:46  (46      Secs)
SIGNAL=  Framed,PRBS pattern,DSX/DSX low
*BIT ERROR SUMMARY:
  TotalErr=21         Avg ErrRate=1.0E-08
  ErrorSec=21         %ErrFreeSec=54.3478
  Drib Err=21         DribErrRate=1.0E-08
  BIT THRESHOLD ERROR SECONDS:
   E-6 Sec=0          E-5 Sec=0
   E-4 Sec=0          E-3 Sec=0
*PARITY ERROR SUMMARY:
  TotalErr=21         Avg ErrRate=1.0E-08
  ErrorSec=21         %ErrFreeSec=54.3478
  Drib Err=21         DribErrRate=1.0E-08
  PARITY THRESHOLD ERROR SECONDS:
   E-6 Sec=0          E-5 Sec=0
   E-4 Sec=0          E-3 Sec=INVALID
*STATUS AND EVENT SECONDS:
SigLos=0          A=0          B=0
  Sync=0          C=0          D=0
 Frame=0       Blue=0       Xbit=0
```

NOTE: PRINTOUT SHOWN AT 70% OF ACTUAL SIZE

Fig. 6 - Immediate Summary Printout

Power Loss Recovery Summary Printout

4.12 If summary printouts have been selected and power is interrupted and then regained, a Power Loss Recovery Summary Printout will be generated. This summary gives test results at the time of power loss and the time power was recovered and testing restarted. The second line in the summary indicates the times at which power was lost and restored. The format is identical to other summaries. Figure 7 shows an example printout.

```
07Jan 13:54:43 PWR LOSS RECOVERY SUMMARY
PwrLoss 07Jan 13:54:39 to 07Jan 13:54:43
Elapsed Time=00-00:02:54  (174      Secs)
SIGNAL=  Framed,PRBS pattern,DSX/DSX low
*BIT ERROR SUMMARY:
  TotalErr=709425741 Avg ErrRate=9.2E-02
  ErrorSec=113       %ErrFreeSec=35.0575
  Drib Err=91        DribErrRate=1.2E-08
  BIT THRESHOLD ERROR SECONDS:
   E-6 Sec=60        E-5 Sec=54
   E-4 Sec=51        E-3 Sec=45
*PARITY ERROR SUMMARY:
  TotalErr=263702    Avg ErrRate=3.4E-05
  ErrorSec=113       %ErrFreeSec=35.0575
  Drib Err=91        DribErrRate=1.2E-08
  PARITY THRESHOLD ERROR SECONDS:
   E-6 Sec=60        E-5 Sec=54
   E-4 Sec=27        E-3 Sec=INVALID
*STATUS AND EVENT SECONDS:
SigLos=0          A=0          B=0
  Sync=19         C=0          D=0
 Frame=0       Blue=0       Xbit=53
```

NOTE: PRINTOUT SHOWN AT 70% OF ACTUAL SIZE

Fig. 7 - Power Loss Recovery Summary Printout

Error Second Printouts

4.13 If Error Second Printouts are requested (see Table B - Error Second Printout Displays), a message is printed upon the occurrence of each error second of the error type selected (Parity or Bit). The message includes: Time-Of-Day/Date (accurate to within one second of the end of an error-second), the number of errors in that error-second, and the status of the internal and external events (A, B, C, D, Signal Loss, DS3 Frame Loss, Data Sync Loss, and Blue Signal Detected).

4.14 Since signal loss implies frame and data sync loss, the signal loss event masks the reporting of lost frame and data sync. Error-Second Printouts are formatted as follows:

```
18Mar 17:04:26  Bit=12345678  SigLosBlABCD
18Mar 17:04:26  Par=12345678  FrmSynBlABCD
18Mar 17:04:26  Frm=12345678  FrmSynBlABCD
```

4.15 A feature of the S5200E Receiver is its use of synchronous error-seconds. For synchronous error-seconds, an error-second begins with the detection of an error. All errors falling within a one-second window synchronized to the beginning error are included in that error-second. Status event seconds are not synchronized to error-seconds, but are counted synchronously with elapsed seconds. This fact, and the way in which event occurrences are correlated to error-seconds in error second printouts, lead to the following conclusions:

- Event and error-second totals alone are not sufficient to determine the cause and effect relationships between events and errors. However, they are still useful in assessing overall system performance.

- The way in which event occurrences are correlated to error-seconds provides a high probability of an event which caused an error-second to be recorded in an error-second printout. As a result, error-second printouts are extremely useful in determining cause and effect relationships between events and errors.

4.16 Error-seconds are correlated to event seconds as described in the following paragraphs and illustrated in Figure 8.

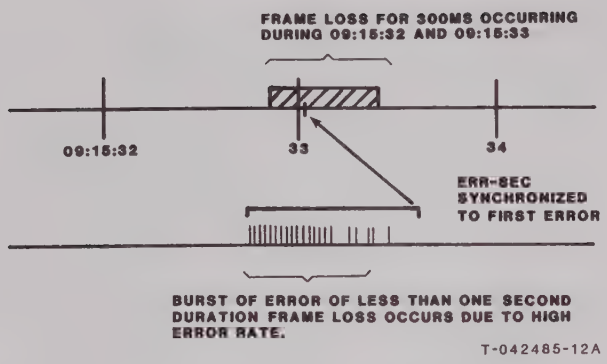

FRAME LOSS FOR 300MS OCCURRING DURING 09:15:32 AND 09:15:33
09:15:32
33
34
ERR-SEC SYNCHRONIZED TO FIRST ERROR
BURST OF ERROR OF LESS THAN ONE SECOND DURATION FRAME LOSS OCCURS DUE TO HIGH ERROR RATE.
T-042485-12A

Fig. 8 - Error Seconds to Event Seconds Correlation

4.17 Status event seconds are synchronized to elapsed seconds. For a parity error second to be correlated and printed with an event second, the synchronous error-second must begin not more than 25 ms before the start of that event second and not more than 975 ms after the start of that event second. An event which causes a parity error second has a 97.5% probability (975 ms/1000 ms) of being recorded with that error-second.

4.18 For a bit error second to be correlated and printed with an event second, the synchronous error-second must begin not more than 325 ms before the start of that event second and not more than 975 ms after the start of that event second. An event which causes a bit error second has a 75% probability (975 ms/975 + 325 ms) of being recorded with that error second.

4.19 Because status event seconds are not synchronized to error seconds, but are counted synchronously with elapsed seconds, the number of status seconds in a summary printout may exceed the number of status events shown in error second printouts.

4.20 Figure 9 gives an example to illustrate this point. It shows that since the burst of errors lasted less than one second, only one error second will be counted and a single error second printed. The time of the error second will be reported as 09:15:33, and the frame loss event will be indicated. Even though the frame loss duration is less than one second, two frame loss seconds will be counted in the totals, and the summary printout will not appear to correlate with the error second printouts.

4.21 The Receiver has the capability to squelch error second printouts on excessive error conditions. Squelching can be enabled or disabled by the user (see Table B - Error Second Squelch Printout Displays). If squelching is selected, error second printouts are squelched when 10 consecutive seconds of the squelch condition are received. A one-line message is formatted and output to the Printer interfaces when printouts are squelched or re-enabled. This message contains the Time-Of-Day/ Date and a clear indication that error seconds are squelched or re-enabled.

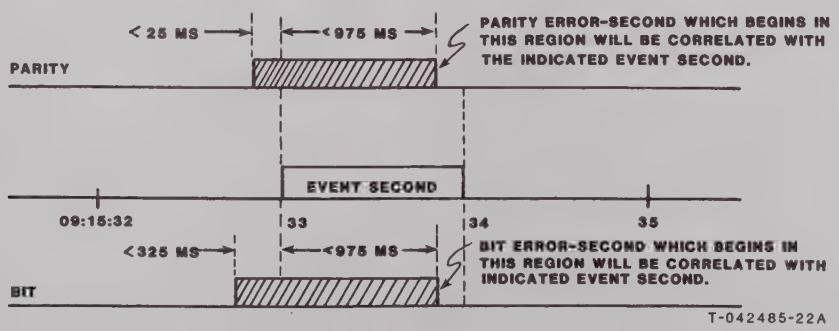


Fig. 9 - Parity and Bit Error Second Correlation Examples

4.22 The squelch condition is user selectable. The conditions which can be set are: error-seconds in which ANY errors are received or in which the error rate exceeded 10^{-6}, 10^{-5}, 10^{-4}, or 10^{-3}. Error-second printouts are re-enabled when 5 consecutive seconds of the absence of the squelch condition are detected. Figure 10 shows a sample printout.

```
18Mar 09:48:28 Bit=31538
18Mar 09:48:29 Bit=31548
18Mar 09:48:30 Bit=31549
18Mar 09:48:31 Bit=31548
18Mar 09:48:32 Bit=31549
18Mar 09:48:33 Bit=31548
18Mar 09:48:34 Bit=31549
18Mar 09:48:35 Bit=31549
18Mar 09:48:36 Bit=31548
18Mar 09:48:37 Bit=31549
18Mar 09:48:37 ERR-SEC PRINTOUT SQUELCHED
18Mar 09:49:56 ERR-SEC PRINTOUT REENABLED
18Mar 09:50:04 Bit = 4
18Mar 09:50:22 Bit = 1
```

NOTE: PRINTOUT SHOWN AT 70% OF ACTUAL SIZE

Fig. 10 - Error Second Squelch Printout

Lost Data

4.23 When data is output from the Receiver faster than the Printer can print it, the data is stored in a 1024-byte queue. If this storage is exceeded, the Receiver will keep track of the number of buffers (40-character lines) lost. When the printer is again ready for data, the number of lost buffers will be reported in hexidecimal notation.

F. Remote Control

4.24 All the S5200E Receiver capabilities that are controlled from the front panel can be remotely controlled via the GPIB and/or RS-232C interfaces (see Appendix A and/or B for complete information on these interfaces). Programming the Receiver via remote control is as simple as programming it from the front panel. Twelve commands correspond to the 12 front panel pushbuttons. These commands must be issued in the same sequence as for the front panel pushbuttons in order for them to be valid. Additional commands are provided to access Receiver setup or signal status and measurements.

Command Syntax and Sequences

4.25 All remote control command sequences must be issued in the following format:

Cmd-1 (delimiter Cmd-2 ... delimiter Cmd-n) <CR> <LF>.

Cmd-1, Cmd-2, and Cmd-n are any of the commands shown in Table D. Command characters are read as 7-bit ASCII data. Upper or lower case characters are accepted and treated the same. Command sequences may contain one or more commands and must be terminated by a carriage return <CR> and a line feed <LF>.

4.26 A command sequence must not exceed 128 characters in length. Multiple commands in a sequence must be separated by only one of the following valid delimiters:

DELIMITER	ASCII CODE (HEX)
SP (Space)	20
Null	00
, (Comma)	2C
; (Semicolon)	3B
HT (Horizontal tab)	09

4.27 The Receiver will backspace and delete received characters when the ASCII backspace (HEX 08) or rubout (HEX 7F) character is received.

S5200E Receiver Response

4.28 When the carriage return and line feed terminating a command sequence are received, the Receiver decodes and responds to the sequence. Multiple commands in a sequence are responded to one at a time. Invalid commands are ignored by the Receiver, but a command error indication is made available to the GPIB and/or RS-232C interfaces. If a multiple command sequence contains an invalid command, valid commands in the sequence will still be interpreted and responded to. Valid commands may be treated as invalid if they have no meaning in the Receiver's current state. For example, the CHANGE and ENTER commands are invalid when no editing is in process. Table D provides a summary of the available commands, queries, and responses.

Queries

4.29 Some commands may be sent with a question mark (?), which makes them queries. The response to most queries is a single ASCII number. Table D provides a summary of commands and queries.

TABLE D

REMOTE COMMANDS

CONTROL COMMAND	CORRESPONDING BUTTON	QUERY COMMAND	CORRESPONDING LEDS	ASCII RESPONSE
LEV	LEVEL	LEV?	DSX/DSX MON HIGH/LOW BIN & CLOCK BIN ONLY	0 1 2 3
PAT	PATTERN	PAT?	IN SERVICE PRBS 1111/1100 BLUE/1010	0 1 2/4 3
FRA	FRAME	FRA?	FRAMED UNFRAMED	0 1
MOD	MODE SELECT	MOD?	UNTIMED SINGLE REPEAT SINGLE/REPEAT	0 1 2 3
TIM	TIME DISPLAY	NONE	NONE	
RES	START/RESET	RES?	IN PROCESS STOP/END	0 1
STO	STOP/CONTINUE	STO?	IN PROCESS STOP/END	0 1

TABLE D (CON'T)

REMOTE COMMANDS

CONTROL COMMAND	CORRESPONDING BUTTON	QUERY COMMAND	CORRESPONDING LEDS	ASCII RESPONSE
INC	UP ARROW	NONE	NONE	
DEC	DOWN ARROW	NONE	NONE	
ENT	ENTER	NONE	NONE	
CAT	CATEGORY	CAT?	NONE	See NOTE 1
FUN	FUNCTION	FUN?	NONE	See NOTE 2
REM	NONE- GO TO REMOTE CONTROL	REM?	REMOTE (IF LOCAL)	1 0
LOC	NONE- GO TO LOCAL CONTROL	LOC?	REMOTE (IF LOCAL)	1 0
CLR	RETURN TO POWER UP STATE	NONE	NONE	
SNAPSHOT CURRENT STATUS		STA?	CURRENT SIGNAL STATUS	See NOTE 3
SNAPSHOT HISTORY STATUS		HST?	SIGNAL STATUS HISTORY	See NOTE 4
SNAPSHOT DISPLAY		DSP?	NONE	See NOTE 5

NOTE 1: The response to the CAT? query will be a single ASCII number or letter indicating the nature of the current display. The types of displays ("categories," sort of) and the corresponding ASCII responses to the CAT? query are:

DISPLAY "category"	ASCII response
PARITY category	0
BIT category	1
FRAME category	2
BPV category	3
STATUS category	4
PRINTER category	5
ALARM category	6
AUXILIARY category	7
TIME display	8

TABLE D (CON'T)

REMOTE COMMANDS

DISPLAY "category"	ASCII response
MODE and interval setting	9
Category selection	A

NOTE 2: The response to the FUN? query is a single ASCII number or letter indicating which "function" is currently displayed within the currently displayed "category." The reason why "function" and "category" are in quotes is that not all displays possible are listed on the front panel under the CATEGORY button, but the Receiver software treats all displays as "categories." The possible "function" displays and their corresponding ASCII responses are as follows:

ASCII RESPONSES TO FUN? QUERY

CATEGORY	FUNCTION	ASCII RESPONSE
PAR, BIT, FRAME	Err Rate Now, Total Err	0
	Avg Err Rate, Elap	1
	Avg Err Rate, Drib Rate	2
	% ErFree Sec, Elap	3
	Error Sec, Total Err	4
	Thresh Err Sec E-6,E-5	5
	Thresh Err Sec E-4,E-3	6
BPV	Err Rate Now, Total Err	0
	Avg Err Rate, Elap	1
	% Err Free, Elap	2
	Error-Sec, Total Err	3
STATUS	Signal Loss	0
	Frame Loss	1
	Sync Loss	2
	Blue-Signal Detect	3
	X-bit Detect	4
	External A	5
	External B	6
	External C	7
	External D	8
	Clear History LED prompt	9
	Power-Loss message	A
PRINTER	Immediate Summary	0
	End-of-Interval Summary	1
	Error-Second Printouts	2
	Error-Second Squelch	3

TABLE D (CON'T)

REMOTE COMMANDS

CATEGORY	FUNCTION	ASCII RESPONSE
ALARM	Error Rate	0
	Signal Loss	1
	Frame Loss	2
	Sync Loss	3
	Blue Signal	4
AUXILIARY	Time-of-Day/Date	0
	"Do not disturb" message	1
	"Press ENTER for XXX" prompt	2
TIME	Time-of-Day/Date	0
	Single Elapsed	1
	Single Remaining	2
	Single Interval	3
	Repeat Elapsed	4
	Repeat Remaining	5
	Repeat Interval	6
MODE	Untimed	0
	Single	1
	Repeat	2
	Single/Repeat	3
Category-Selection	PARITY	0
	BIT	1
	FRAME	2
	BPV	3
	STATUS	4
	PRINTER	5
	ALARM	6
	AUXILIARY	7

NOTE: Not all time displays are always available. Those that are not available vary with the MODE as follows:

TIME MODE	TIME DISPLAY	ASCII RESPONSE
UNTIMED	TIME-OF-DAY/DATE	0
	ELAPSED	1
SINGLE	TIME-OF-DAY/DATE	0
	SINGLE ELAPSED	1
	SINGLE REMAINING	2
	SINGLE INTERVAL	3

TABLE D (CON'T)

REMOTE COMMANDS

TIME MODE	TIME DISPLAY	ASCII RESPONSE
REPEAT	TIME-OF-DAY/DATE	0
	REPEAT ELAPSED	4
	REPEAT REMAINING	5
	REPEAT INTERVAL	6
SINGLE/REPEAT	TIME-OF-DAY/DATE	0
	SINGLE ELAPSED	1
	SINGLE REMAINING	2
	SINGLE INTERVAL	3
	REPEAT ELAPSED	4
	REPEAT REMAINING	5
	REPEAT INTERVAL	6

NOTE 3: The response to the STA? query is a five-character ASCII "number" terminated by a carriage return and line feed indicating which signal status indicators are true. There is one character for each status indicator as follows:

XBDFS

Where X=X-bit
B=Blue Signal detect
D=Data Sync Loss
F=Frame Loss
S=Signal Loss

Each character will be set to ASCII 1 if its corresponding condition is true, or set to ASCII 0 if the condition is false. For example, if there is currently a Blue Signal detect, the response to the STA? query would be 01000.

NOTE 4: The response to the HST? query has the same format as the response to the STA? query; however, instead of indicating the current signal status, it indicates if any of the signal status conditions have been detected during the course of the test in progress (if Untimed or Single mode) or the test just completed (if in Repeat or Single/Repeat mode).

NOTE 5: The response to the DSP? query is a copy of the 40-character display, followed by a carriage-return and line-feed. No provision is made to indicate flashing fields.

G. Power Up and Power Loss Processing

Power Up Initialization

4.30 When power is applied and the Receiver is turned ON, the Receiver will execute its power-on sequence. The following procedure explains the power-on sequence.

STEP	PROCEDURE
1	Determine if this is a recovery from a power loss (warm start) or an initial turn-on (cold start).
2	If this is a warm start, initialize the Receiver as described in "Recovery from Power Loss" at the end of this subsection.
3	If this is a cold start, some basic diagnostics including a program checksum and RAM read/write test will be performed. Failures will be reported to the front panel. An internal DIP switch, located on the Status and Control PCB, governs whether the Receiver halts on failure or attempts to restart after approximately five seconds.
4	If the diagnostics are successful, all test set hardware and software are initialized to the default power-up state. Table E identifies the default power-up state for all front panel displays, indicators, and controls.

TABLE E

DEFAULT POWER UP STATES

DS3 INPUT:

LEVEL = DSX
PATTERN = LIVE
FRAMING = FRAMED

STATUS:

SIGNAL LOSS, FRAME LOSS, PAT SYNC LOSS, BLUE SIG DET cleared
HISTORY CLEARED
REMOTE CONTROL = OFF

TIME MODE:

MODE = UNTIMED
ELAPSED TIME reset to 0
SINGLE, REPEAT INTERVALS = 00-0000:10
TEST = IN PROCESS

TABLE E (CON'T)

DEFAULT POWER UP STATES

DISPLAY:

PARITY FUNCTION = Current error rate and total errors
BIT, BPV, FRAME = Current error rate and total errors
STATUS SECONDS = Signal loss
ALARM FUNCTION = Error Rate

PRINTER FUNCTIONS:

END-OF-INTERVAL SUMMARY = OFF
ERROR SECOND PRINTOUTS = OFF
ERROR SECOND SQUELCHING = NOT ENABLED

Power Loss Protection

4.31 When power is lost, a non-maskable interrupt alerts the microprocessor. In response, software computes and stores a checksum of the variables which define the state of the Receiver. For reliability, an 8-bit checksum and its 8-bit complement are stored in successive locations in non-volatile RAM. Control variables, as well as current time and measurements, all reside in 1K x 8 non-volatile RAM.

Recovery From Power Loss

4.32 When power is restored and the recomputed checksum matches the stored control variable checksums, a power loss "warm start" will be initiated. A Power Loss Summary and recovery message will then be printed, as described in subsection D. Printer Outputs - Power Loss Summary Printout.

4.33 In addition, a power loss message will be displayed on the front panel, indicating the time of power loss and recovery from power loss.

4.34 The Receiver will be initialized to the state it was in at the time of the power loss, except that testing will be restarted, not continued.

SECTION 5

THEORY OF OPERATION

5. THEORY OF OPERATION

A. General

5.01 The S5200E Receiver consists of seven plug-in printed circuit boards, a motherboard, a front panel display board, and a rear panel printed circuit board (see Figure 11). If the IEEE-488 GPIB Interface option is installed, an additional plug-in circuit board is installed. There are two power supplies, a +5 volt supply at 12 amps and a -5.2 volt supply at 6 amps.

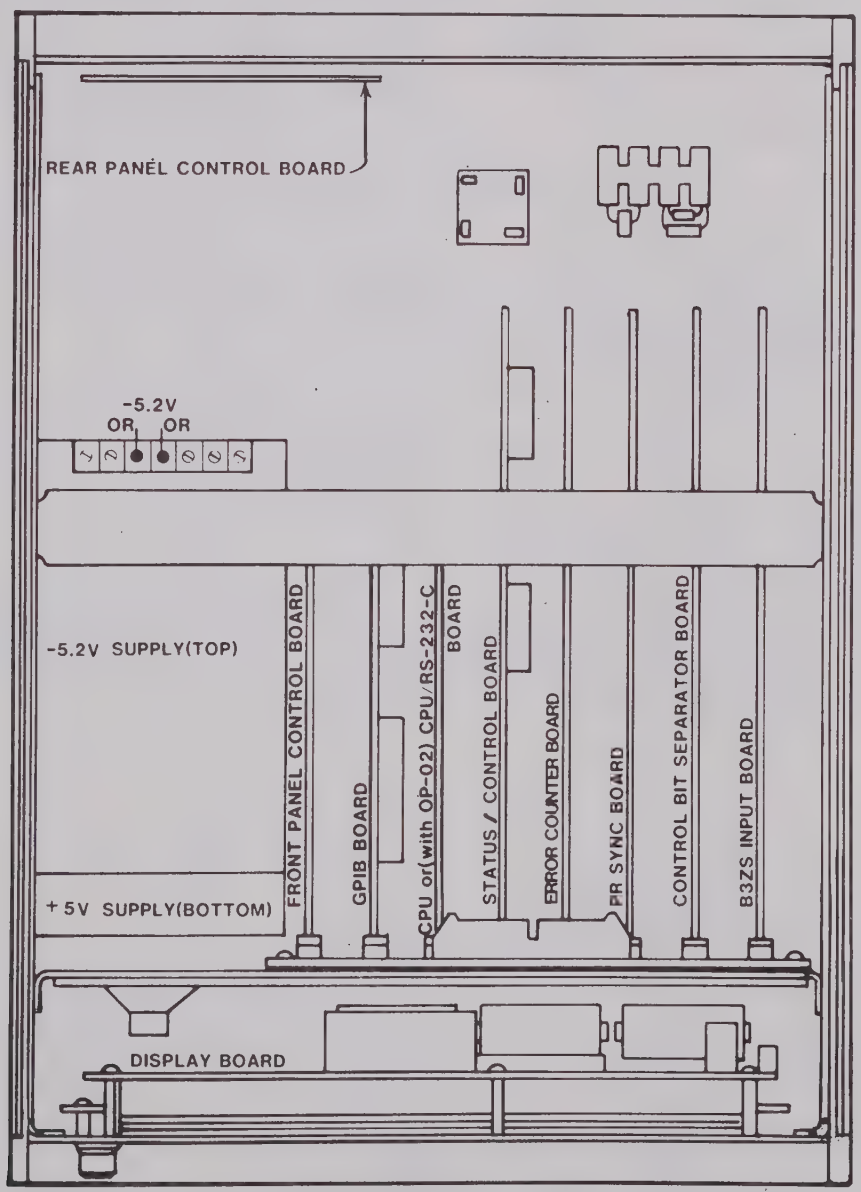


Fig. 11 - S5200E Receiver Printed Circuit Board Configuration

5.02 The plug-in boards are divided into two sections:

High-speed section

- B3ZS Input board
- Control Bit Separator board
- PR Sync board
- Error Counter board

Software/Hardware section

- Status and Control board
- GPIB board (optional)
- CPU/RS-232C board (RS-232C is optional)
- Front Panel Control board.

5.03 All eight plug-in boards plug into a motherboard which is also divided into the same two sections, High-Speed and Software/Hardware. The Software/Hardware section is an STD 8-bit microprocessor system.

5.04 Figure 12 is a system functional block diagram which shows the relationship of the integral parts to the system in general. The theory of operation of individual boards follows.

B. B3ZS Input Board

5.05 When the input is selected for either DSX/DSX LOW or HIGH/LOW, the DS3 signal goes through an AGC amplifier that works with an input signal level about 30 dB below the normal DSX3 cross-connect level. The signal from the AGC amplifier is converted to Return-to-Zero (RZ) data which is then fed to a phase-locked loop for timing recovery. The RZ data and timing information are sent to the Control Bit Separator and PR Sync boards. The recovered timing information is also sent to a rear panel monitor BNC connector.

5.06 The B3ZS Input board also detects bipolar violations (BPV) in the B3ZS signal. The BPV output is sent to the Error Counter board and the BPV output BNC connector on the rear panel.

5.07 When the BINARY DATA & CLOCK or BINARY DATA ONLY input format is selected, the AGC amplifier and phase-locked loop are by-passed.

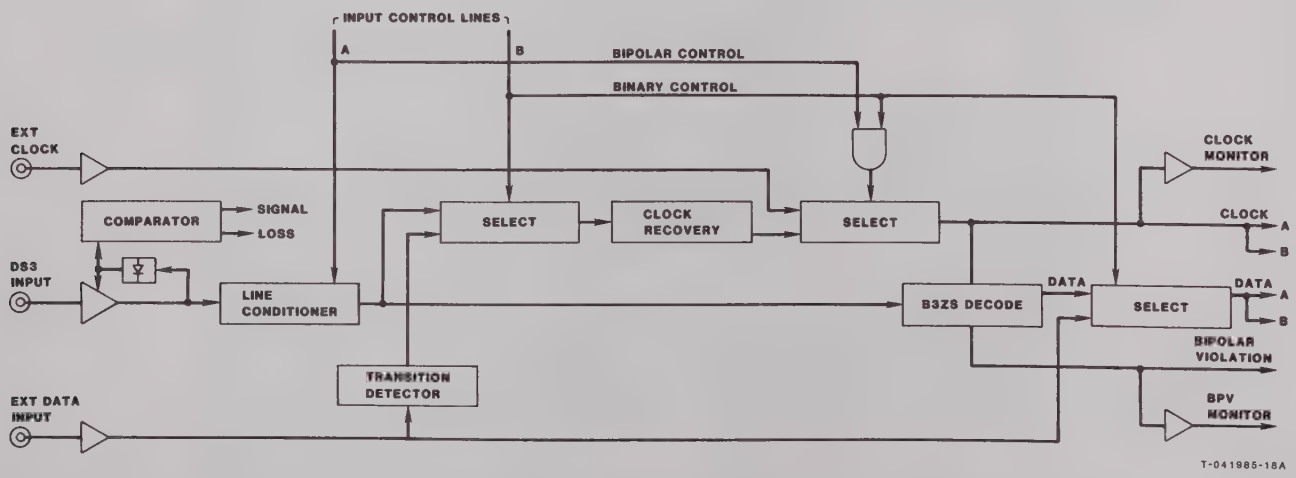


Fig. 13 - B3ZS Input Board Functional Block Diagram

5.08 The no-signal alarm is generated on the B3ZS Input board and is applied to the Status and Control board where it is read by the system software and displayed on the front panel SIGNAL LOSS indicator.

5.09 Different binary data and clock input options can be strapped on the B3ZS Input board. There are four jumper plugs located in the left-hand corner of the board when observing the component side with the connector fingers to the left.

5.10 The clock jumper is labeled EXT CLK and is normally in the 0V, TTL position. It is AC coupled, and this position provides operation at 0 volt or TTL thresholds with a 75 ohms-to-ground input. Moving this jumper to the ECL position, which is just above the 0V, TTL position, provides a 75 ohms to -2 volt input and operation at ECL thresholds.

5.11 The three jumpers to the right of the clock jumper are grouped and labeled EXT DATA. One of the jumpers is labeled DC and provides DC coupling of input data. If this jumper is removed, the data input is AC coupled. The remaining two jumpers are normally in the 0V position, providing a 0 volt threshold and a 75-ohm input to ground. The TTL position requires moving one of these jumpers to provide TTL thresholds, 75 ohms-to-ground input. ECL thresholds, 75 ohms to -2 volts input, requires moving both jumpers from the normal position to that labeled ECL.

C. Control Bit Separator Board

5.12 The Control Bit Separator board is used only when the Receiver is in the framed mode of operation.

5.13 The inputs to the board are the 44.736 Mb/s data and timing from the B3ZS Input board. The output is a 44.2 MHz gapped clock that is sent to the PR Sync board.

5.14 The Control Bit Separator board locates the DS3 frame information, counts parity on the incoming data and compares it to the transmitted parity bit, and generates parity errors whenever the parity bits do not compare. It also removes the information data from the DS3 signal and sends it to the PR Sync board. The parity errors are sent to the Error Counter board and to the rear-panel connector.

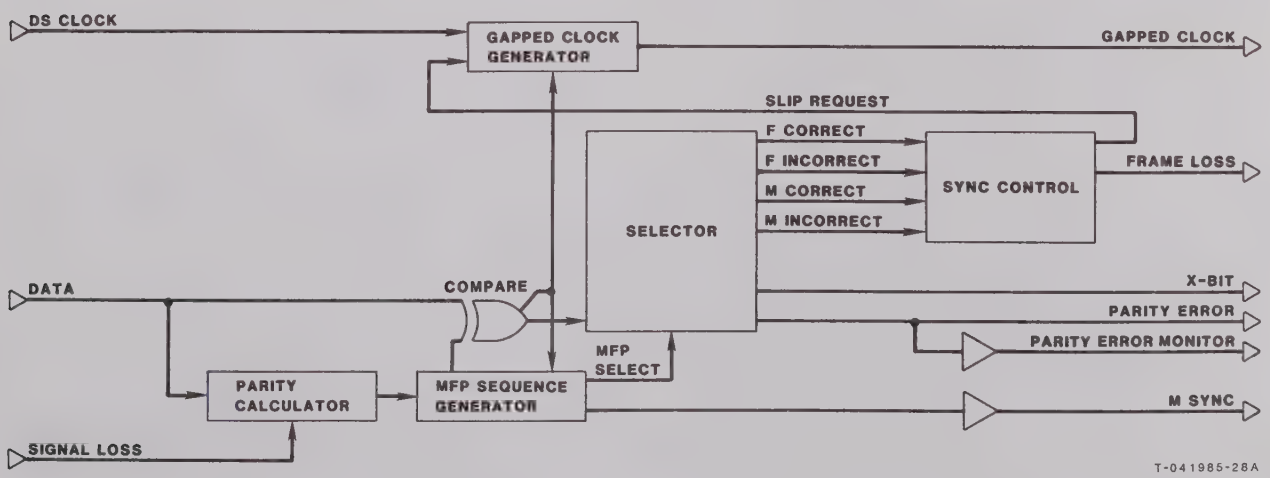


Fig. 14 - Control Bit Separator Board Functional Block Diagram

5.15 In addition, the Control Bit Separator board generates the out-of-frame signal and the X-bit signals. These signals are sent to the front-panel status indicators and to the rear-panel monitor connector.

D. PR Sync Board

5.16 The PR Sync board synchronizes to the incoming data and searches for errors in the data. It consists of a 2^{15}-1 pseudorandom sequence generator, a clock-select circuit, a blue-signal detector, and a data-sync circuit.

5.17 When in the unframed mode, the input is a 44.736 Mb/s data and timing signal from the B3ZS Input board. The data input is a 2^{15}-1 pseudorandom sequence that is generated by the S5200E Transmitter. The data is forced into the 2^{15}-1 sequence generator to synchronize the generator to the incoming data pattern. When the generator is synchronized, it will be forced into its free-running mode. At this time, the incoming data is compared to the sequence generator data on a bit-by-bit basis. Whenever any bit does not compare, a bit error is generated and sent to the Error Counter board.

5.18 When in the framed mode, the operation is the same except the timing input is selected from the Control Bit Separator board. This timing input is the DS3 clock except it has a pulse missing every 85th clock pulse. The missing pulse represents the frame information in the DS3 format. This timing input, called the gapped clock, reads the 2^{15}-1 data pattern into the sequence generator but, because of the missing clock pulse, it does not read the frame information into the sequence generator.

5.19 The PR Sync board also detects the blue signal in the framed mode of operation. The blue signal is a 1010 signal every 84 bits followed by one frame bit. When the Receiver is monitoring live traffic, the only function of the PR Sync board is detection of the blue signal.

5.20 The sync-loss alarm and blue-signal detected signals are generated by the PR Sync board and sent to the Status and Control board where they are read by the system software and displayed on the front panel status indicators.

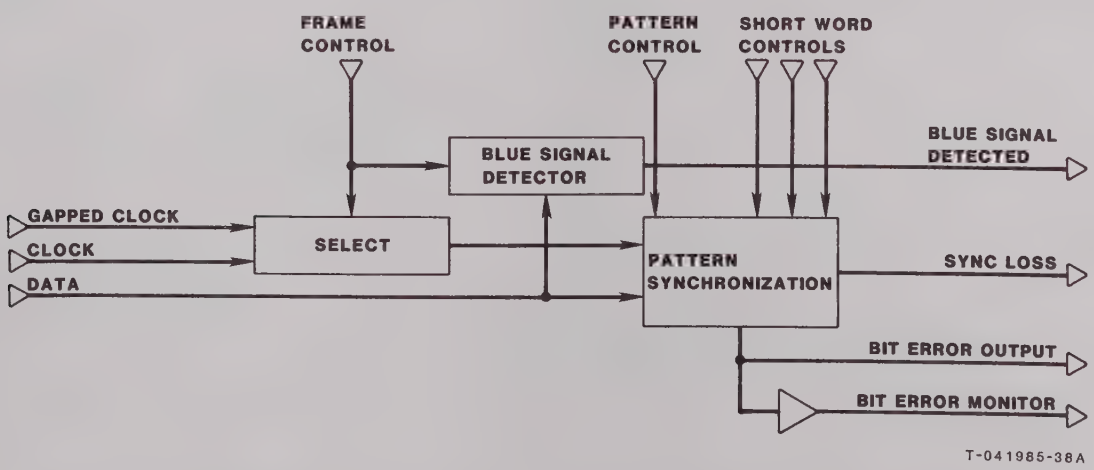


Fig. 15 - PR Sync Board Functional Block Diagram

E. Error Counter Board

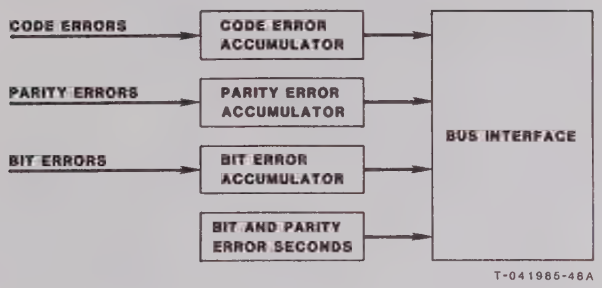


Fig. 16 - Error Counter Board Functional Block Diagram

5.21 The Error Count board contains the accumulators for counting the bit-errors, parity errors, bipolar violations, bit error-seconds, and parity error seconds. Bit errors from the PR Sync board are counted by a 2^{24} bit binary counter on the Error Counter board. The counter is a ripple type counter that consists of three 8-bit words. Each 8-bit word is latched by the microprocessor software into a storage register located on the Error Counter board. The storage register is addressed by the microprocessor and the 8-bit words are read onto the microprocessor bus through the bus interface circuitry.

5.22 Bipolar violations from the B3ZS Input board are also counted by a 2^{24} binary counter that operates in the same way as the bit-error accumulator. Parity errors come in at a much lower rate than bit errors or bipolar violations so an 8 bit counter is used.

5.23 Bit-error seconds and parity-error seconds are also generated on the Error Counter board and both operate in the same way. When an error is detected, a one-second timer is started. At the end of one second an error flag is set. When the flag is high, the microprocessor reads it as an error-second, resets the flag low, and adds a count to the error-second accumulator in the software.

F. Status and Control Board

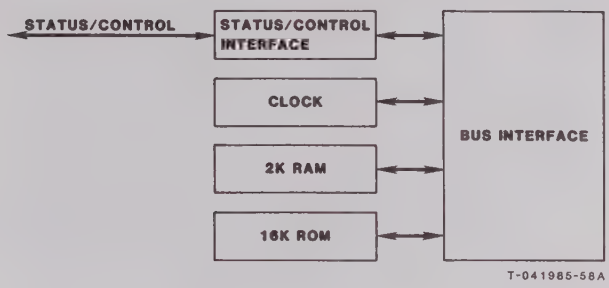


Fig. 17 - Status and Control Board. Functional Block Diagram

5.24 The Status and Control board is part of the Software/Hardware section and interfaces to the 8-bit microprocessor STD bus through the 56-pin edge connector on the front of the board. The other connectors interface with the Status and Control bus and the rear-panel printed circuit board.

5.25 The time-of-day clock is located on the Status and Control board. Its only function is to maintain the time-of-day. The test time is controlled by the microprocessor and is not related to the time-of-day clock. The time-of-day clock is useful when the Receiver is operating in the printer mode to correlate time-of-day with errors on the hard-copy printout.

5.26 The board contains locations for 2k bytes of RAM and 16k bytes of ROM for the system software. Of the 2k of RAM, 1k is non-volatile and derives its power from three 1.2V batteries when the Receiver loses its primary power input. The Receiver status is fed into the 1k RAM on power loss. When power is restored, the microprocessor reads the contents of the 1k RAM and places the Receiver in the same mode it was in before power was lost.

5.27 The Status and Control board receives the status information (signal loss, frame loss, blue signal,

etc.) from the high-speed boards and applies it to the 8-bit microprocessor bus. The microprocessor then turns on the proper front panel indicators, counts, and displays, in seconds, the time the alarm was active.

5.28 The Status and Control board also receives the four event inputs (A, B, C, and D) from the rear-panel monitor connector and applies them to the bus for access by the microprocessor.

5.29 The operational mode, frame, pattern, and level of the Receiver are controlled by the microprocessor through the Status and Control board. When an operational mode is selected by a front panel pushbutton, the information is applied to the Status and Control board through the STD bus. This information is converted to the proper logic signal levels by the Status and Control board and sent to the Status and Control bus to control the high-speed boards. The levels: DSX/DSX LOW, HIGH/LOW, BINARY DATA & CLOCK and BINARY DATA ONLY are sent to the B3ZS Input board. The frame information is sent to the Control Bit Separator board, and the pattern information is sent to the PR Sync board.

5.30 In addition, four DIP switches or jumper blocks on this board provide configuration information to the Receiver software. Switch settings and meanings are shown in Table F.

TABLE F

STATUS AND CONTROL BOARD

SWITCH/JUMPER CONFIGURATIONS

SWITCH	JUMPER BLOCK	MEANING
S1-1 OFF	D OUT	Halt on software detected failure
S1-1 ON	D IN	Restart on software detected failure
S1-2 OFF	C OUT	No RS-232C receive capability
S1-2 ON	C IN	RS-232C receive capability
S1-3 OFF	B OUT	No RS-232C XMIT capability
S1-3 ON	B IN	RS-232C XMIT (printer) capability
S1-4 OFF	A OUT	Mostek CPU board installed
S1-4 ON	A IN	Tau-tron CPU board installed

G. CPU Board

5.31 The CPU board performs the central processing functions and the serial interfacing function (if RS-232C is installed).

5.32 The CPU is a Z80 microprocessor and generates all the signals used to control the 8-bit STD bus. The input/output of the bus is through a 56-pin edge connector on the front of the module.

5.33 The board contains the microprocessor system 2.4576 MHz clock, 2k of RAM used for system software, the Z80 microprocessor, and the input/output bus interface circuitry.

5.34 Some receivers may have the CPU-only board in which case the RS-232C interface will not have been installed. The RS-232C serial interface is an option, and when installed, the circuitry that controls the interface is located on the CPU board.

5.35 Information from the 8-bit microprocessor bus is fed into a Universal Asynchronous Receiver Transmitter (UART) and fed out of the UART in serial form to the RS-232C interface circuitry. The output baud rate of the interface is set by a baud-rate 8-section DIP switch located on the rear panel of the Receiver.

H. GPIB Board

5.36 This board is installed as part of the optional GPIB Interface. It provides the interface between the GPIB connector and the microprocessor. Most of the implemented GPIB functions are handled by a 40-pin GPIB talker/listener LSI IC under microprocessor control. GPIB program memory, read/write variables, and output buffer RAM reside on this board.

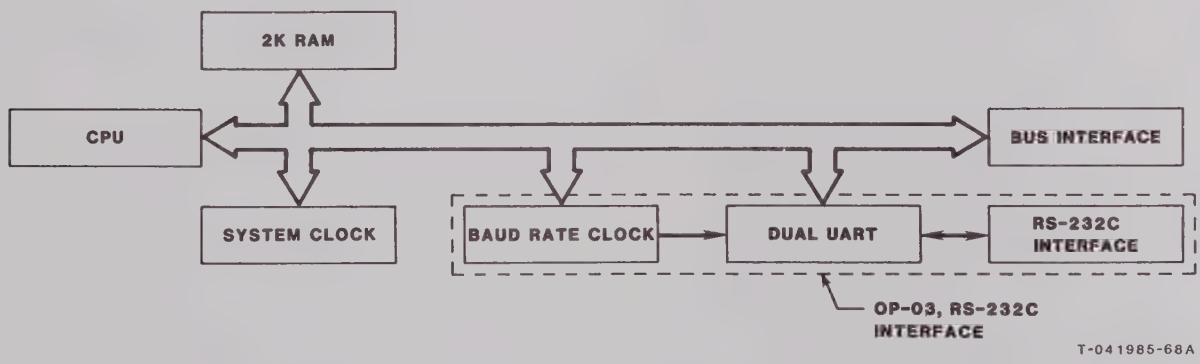


Fig. 18 - CPU Board Functional Block Diagram

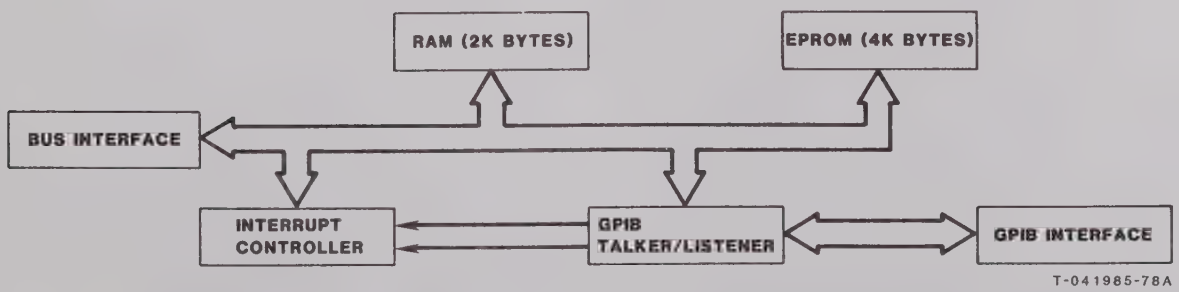


Fig. 19 - GPIB Board Functional Block Diagram

5.37 Four LED's on this board indicate GPIB status. They are labeled with single-character identifiers and have the following meanings:

LABEL	MEANING
T	ON when addressed to talk
L	ON when addressed to listen
R	ON when under remote control
S	ON when S5200E is requesting service

I. Front Panel Control Board

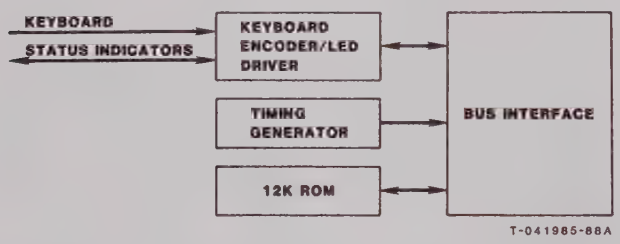


Fig. 20 - Front Panel Control Board Functional Block Diagram

5.38 The Front Panel Control board is part of the Software/Hardware section and interfaces to the microprocessor bus through the 56-pin edge connector on the front of the board. The other connectors interface with the 40-character display and the front panel pushbutton assembly.

5.39 The board contains 12k of EPROM that is used for part of the system software. It receives error information from the error counter; it also receives status information from the Status and Control board by the STD bus and applies it to the front panel 40-character display for readout.

5.40 Also, the Front Panel Control board accepts information from the front panel. Whenever a pushbutton is pressed, the board sends the information over the STD bus to perform the proper function within the system.

SECTION 6

SERVICE AND MAINTENANCE

6. SERVICE AND MAINTENANCE

A. Assistance

6.01 For service assistance, call the Tau-tron Customer Service Dept. (617) 692-5100 or 1-800-TAU-TRON. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

B. Repair/Returns

6.02 If it is determined that the S5200E Receiver must be returned to the factory for repair, use the Repair/Returns Card at the back of this manual and follow the directions to insure prompt service.

C. Routine Service

6.03 The fan air filter on the rear panel of the S5200E Receiver must be cleaned and vacuumed periodically. The dustier the working environment is, the more frequently this task must be performed.

6.04 Use the following procedure to clean the air filter:

STEP	PROCEDURE
1.	Remove the two screws from the filter holder, and remove the holder and sponge-rubber filter.
2.	Use a vacuum cleaner to clean the air filter.
3.	Reinstall the filter and holder; secure with the two screws.

WARNING: Failure to keep the fan air filter clean may result in the overheating of the S5200E Receiver, causing damage to the Unit.

6.05 Other than occasionally cleaning the exterior surface with a mild cleaner, no other periodic maintenance of the Receiver is required.

D. General Troubleshooting

WARNING: Do not attempt to access the inner printed circuit boards without first disconnecting the power cord.

Printed Circuit Boards

6.06 Plug-in printed circuit boards may loosen from their sockets or ribbon cables may become disconnected. If this occurs, perform the following procedure:

STEP	PROCEDURE
1.	Remove the top enclosure to get access to the printed circuit boards in the Receiver.
2.	Check that all the printed circuit boards are properly seated in the motherboard connectors.
3.	Check that all the interconnecting ribbon cables are properly secured to the printed circuit boards.
4.	Replace the top enclosure removed in step 1.

Power Supply Voltage Test

6.07 Figure 21 illustrates the test points used to check the internal power supply voltages. The voltages should be +5 volts ± 0.2 volts and -5.2 volts ± 0.2 volts.

6.08 A nickel cadmium battery pack, containing three 1.2 volt C-size batteries, is used in the Receiver to

preserve front panel settings in case of a power failure. This provides the Receiver with the capability to retain and remember the front panel settings during a power failure. If the batteries are discharged or disconnected, the front panel power up conditions will be incorrect. The location of the batteries is shown in Figure 21.

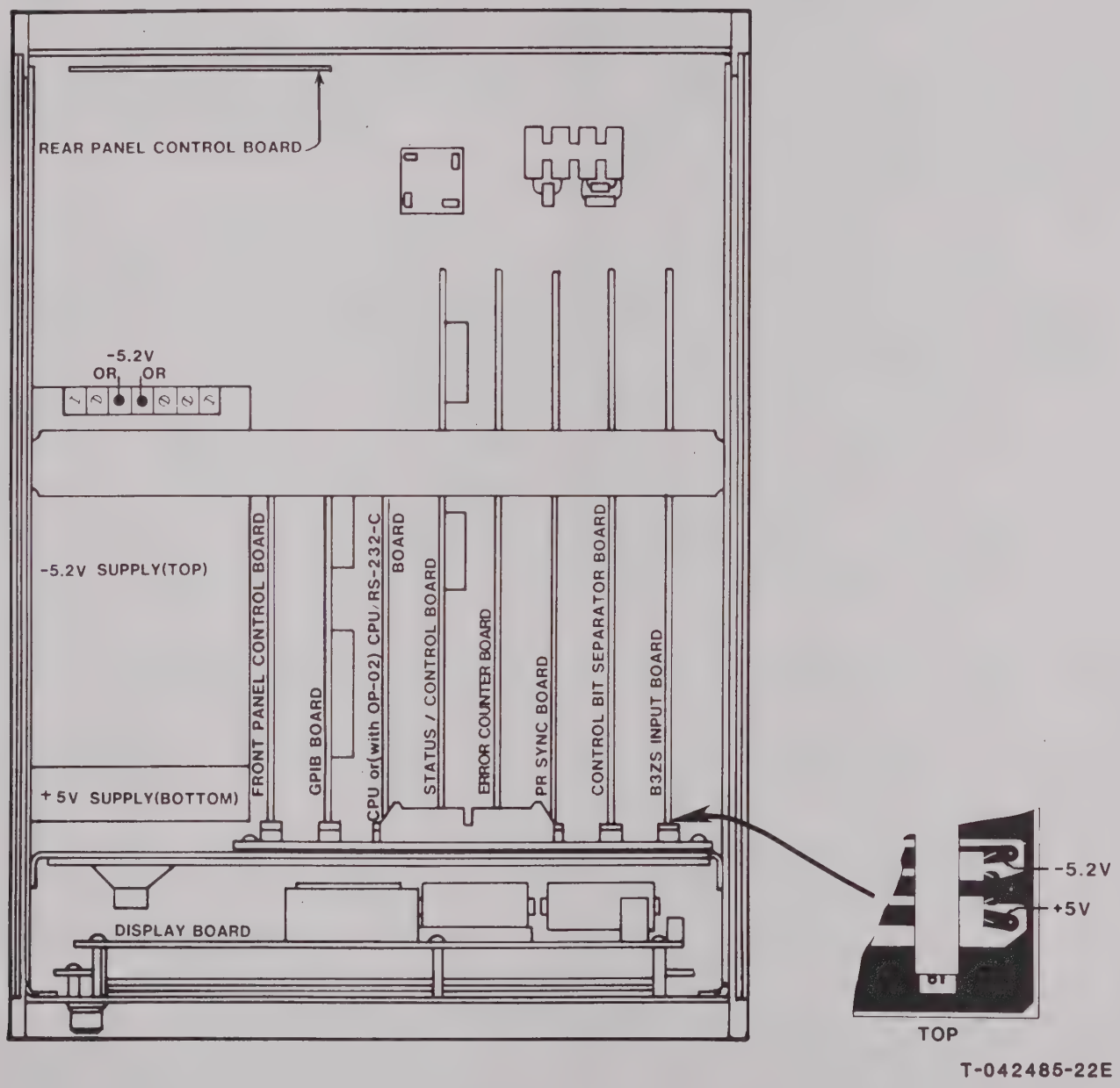


Fig. 21 - Power Supply Voltage Test Points and Nickel Cadmium Battery Location

APPENDIX A

IEEE-488 (GPIB) INTERFACE

APPENDIX A
IEEE-488 (GPIB) INTERFACE

A. General

A.01 This appendix provides an introduction to the GPIB (General Purpose Interface Bus) and explains the operation of the S5200E Receiver under GPIB for those units with the IEEE-488 Interface option installed. The S5200E Receiver may communicate with other GPIB compatible devices as a talker/listener or as a talker only.

B. Introduction

A.02 The GPIB transfers data and commands between the units of an instrumentation system on 16 lines. The interface functions for each unit are performed within the unit; therefore, only passive cabling is necessary to connect the sytem.

A.03 Eight of the lines, DI01 through DI08, are reserved for the transfer of data and other messages in a byte-serial, bit-parallel manner. Data and message transfer are asynchronous and are coordinated by the three handshake lines: DAV (data valid), NRFD (not ready for data), and NDAC (not data accepted). The other five lines are for control of bus activity.

A.04 Devices connected to the bus may be talkers, listeners, or controllers. The controller dictates the roll of each of the other units by setting the ATN (attention) line true and sending talk or listen addresses on the data lines (DI01 through DI08). Addresses are set into each device at the time of system configuration either by switches built into the unit or by jumpers on a printed circuit board. While the ATN line is true, all units must listen to the data lines. When the ATN line is false, only devices that have been addressed will actively send or receive data. All others ignore the data lines.

A.05 Several listeners can be active simultaneously, but only one talker can be active at a time. Whenever a talk address is put on the data lines, while ATN is true, all other talkers should be automatically unaddressed.

A.06 Information is transmitted on the data lines under sequential control of the three handshake lines. No step in the sequence can be initiated until the previous step is completed. Information transfer can proceed as fast as units can respond, but no faster than allowed by the slowest device being addressed as active. This permits several devices to receive the same message byte concurrently.

A.07 The ATN line is one of the five control lines. When ATN is true, addresses and universal commands are transmitted on only seven of the data lines using ASCII code. When ATN is false, any code of eight bits or less understood by both the talker and listener(s) can be used.

A.08 The other control lines are: IFC, REN, SRQ, and EOI. IFC (interface clear) places the interface system in a inactive state. REN (remote enable) is used with other coded messages to select either local or remote control of each unit.

A.09 Any active unit can set the SRQ (service request) line to true. This indicates to the controller that some unit on the bus wants attention; for example, a counter on a bus may want attention because it has just completed a time-interval measurement and wants to transmit the reading to a printer.

A.10 EOI (end or identify) is used by a unit to indicate the end of a multiple-byte transfer sequence. When a controller sets both ATN and EOI lines to true, each unit capable of a

parallel poll indicates its current status on the data line (DI01 through DI08) assigned to it.

A.11 It is not necessary that every unit be capable of responding to all lines. Each unit can be designed to respond only to those lines that are pertinent to its functions on the bus.

S5200E Receiver GPIB Capabilities

A.12 The S5200E Receiver may be interfaced as a talker/listener or as a talker only. The following GPIB capabilities, as described in the IEEE-488-1978 standard, are implemented:

- SH1 Complete source handshake
- AH1 Complete acceptor handshake
- T5 Basic talker, serial poll, talk only, unaddress if addressed to listen
- TEO No extended talker (secondary talk address) capability
- L4 Basic listener, no listen only, unaddress if addressed to talk
- LEO No extended listener (secondary listen address) capability
- SR1 Complete service request capability
- RL2 No local lockout on remote/local capability
- PPO No parallel poll capability
- DC1 Complete device clear capability
- DT1 Complete device trigger capability
- CO No control capability
- E2 Tri-state drivers are used on DI0 lines to achieve maximum data transfer rates.

C. GPIB Interface Connections

A.13 A 24-pin GPIB connector is located on the rear panel of the S5200E Receiver. The connector is mounted on all units, but is operational only on those units equipped with the IEEE-488 Interface option. Tri-state drivers are used on the DI0 lines in the talk mode to achieve higher data transfer rates.

GPIB Address and Option Selection

A.14 An 8-section DIP switch is located on the rear panel adjacent to the GPIB connector. It is used to select and set the GPIB talk/listen address. Table G and Figure 22 explain the DIP switch settings.

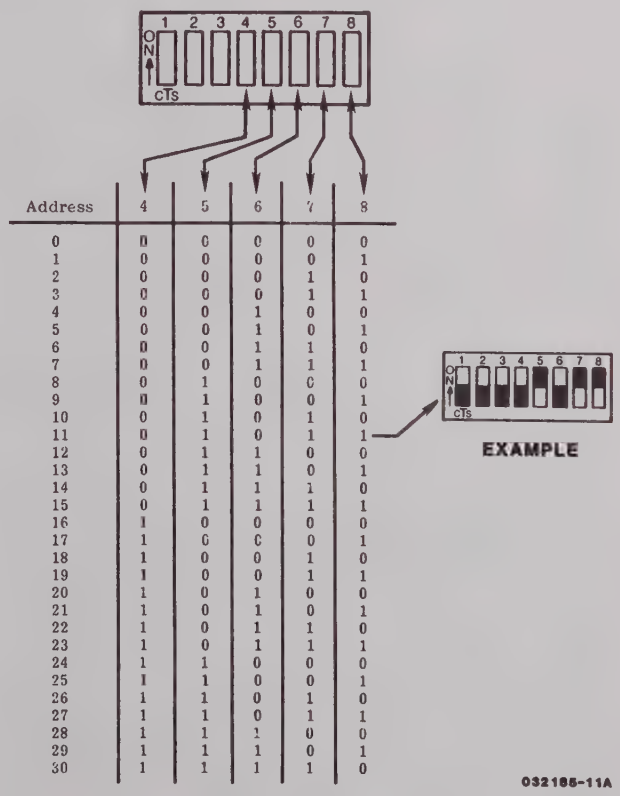


Fig. 22 - GPIB Address DIP Switch Setting

TABLE G

GPIB DIP SWITCH SETTINGS

SWITCH	FUNCTION	DESCRIPTION
1	SRQ Enable	When set to ON, the S5200E Receiver is allowed to generate service requests (assert the GPIB SRQ line). In systems with many GPIB units, this may not be desirable. Service requests can be inhibited by setting this switch down to its off position. The S5200E Receiver maintains status and will respond to serial polls regardless of the SRQ Enable setting.
2	Talk Only	When set to ON, the S5200E Receiver is allowed to be used in a system with a listen-only printer and no controller. In this mode, print functions can be selected from the front panel and the printer output sent to a GPIB printer. The S5200E Receiver will ignore all GPIB commands when in a talk-only mode (switch 2 up).
3	Listen Only	This setting is ignored by the S5200E Receiver since it does not have a listen-only mode of operation.
4 5 6 7 8	Address A5 Address A4 Address A3 Address A2 Address A1	A1 thru A5 plus two additional bits, which are independent of the switch settings, form a 7-bit talk and listen address. Al is the least significant bit, A2 is the next most significant, etc. The two additional bits are the most significant bits. They are fixed as 1-0 for a talk address and as 0-1 for a listen address. Once the five address bits A1 thru A5 are selected, both talk and listen addresses are specified for the receiver.
NOTE: THE DIP SWITCH IS READ ON POWER-UP ONLY. To change the S5200E Receiver's GPIB address or other characteristics, the Receiver must be turned OFF, reset, and then turned ON.		

D. S5200E Response To GPIB Commands

A.15 The S5200E Receiver does not respond to all GPIB capabilities. The following is a list of commands and events that are supported by the S5200E Receiver:

- S5200E RX addressed to listen (MLA)
- Universal unlisten command (UNL)
- S5200E RX addressed to talk (MTA)
- Universal untalk command (UNT)
- Data byte received (DBR)

- Remote/local command (REN)
- Device clear command (SDC, DCL)
- Device trigger command (GET)
- Serial poll enable/disable command (SPE,SPD).

A.16 Several GPIB capabilities are not supported by the S5200E Receiver. The following commands are ignored:

- Local lockout
- Identify (parallel poll trigger)
- Secondary addresses
- Parallel poll configure/ unconfigure
- Parallel poll enable/disable
- Take control.

A.17 The following paragraphs detail the GPIB commands and events to which the S5200E Receiver will respond.

S5200E Receiver Addressed to Listen

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
MLA	Y 0 1 L L L L L (5 4 3 2 1)	1 x x x x

L1-L5 specify the device dependent bits of the device's listen address as set by the rear-panel DIP switch.

A.18 When MLA (my listen address) is present on the GPIB bus, the S5200E Receiver will be addressed to listen. The Receiver will automatically untalk, if it was previously addressed to talk. The Receiver cannot be configured to talk and listen at the same time. This is to prevent talk data from being interpreted as commands.

Universal Unlisten Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
UNL	Y 0 1 1 1 1 1 1	1 x x x x

A.19 When UNL (unlisten) is present on the GPIB bus, the S5200E Receiver will cease to listen and addressed commands (GET, GTL, and SDC) and data will be ignored. Universal commands (IFC, REN, DCL, SPE, SPD, MLA and MTA) will continue to be recognized and responded to.

S5200E Receiver Addressed To Talk

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
MTA	Y 1 0 T T T T T (5 4 3 2 1)	1 x x x x

T1-T5 on the DIO lines specify the device dependent bits of the device's talk address as set by the rear-panel DIP switch.

A.20 When MTA (my talk address) is present on the GPIB bus, the S5200E Receiver will be addressed to talk. If the Receiver was previously addressed to listen, it will automatically unlisten to prevent output data from being interpreted as commands. Since a GPIB system can have only one talker, unique talk addresses must be selected for each device in the system. All other devices must untalk when the Receiver is addressed to talk. If addressed to talk after SPE (serial poll enable) and before SPD (serial poll disable), the Receiver will respond by putting its status byte on the DI0 lines (described later under the Service Request and Serial Poll Response section). Otherwise, Receiver output data (i.e. measurements) will be placed on the DI0 lines. If the Receiver has nothing to say, it will output one or two null bytes along with EOI.

Universal Untalk Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
UNT	Y 1 0 1 1 1 1 1	1 x x x x
OTA	OTA = SGA ∧ $\overline{\text{MTA}}$	

The UNT code is provided for system use.

A.21 The presence of the UNT (untalk) command or a talk address other than the S5200E Receiver's OTA (other talk address) causes the Receiver to become unaddressed to talk. If service requests are not inhibited and the Receiver still has data it wishes to output, a service request, indicating request-to-talk, will be generated.

Data Byte Received

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
ATN	x x x x x x x x	1 x x x x
DAB	D D D D D D D D 8 7 6 5 4 3 2 1	0 x x x x

D1-D8 specify the device dependent data bits.
The source of the message on the ATN line is always the C function, whereas the messages on the DIO and EIO lines are enabled by the T function.

A.22 When the GPIB ATN (attention) line is inactive and the S5200E Receiver is addressed to listen, bytes received on the eight DI0 lines will be interpreted as device-dependent commands (see Device-Dependent Commands).

Interface Clear Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
IFC	x x x x x x x x	x x x 1 x

A.23 When the IFC (interface clear) line is asserted on the GPIB bus, the S5200E Receiver reinitializes its interface functions as described by IEEE-488-1978 state diagrams. A pending service request will be cleared. However, the status byte in the Receiver is not cleared. It may be polled to determine if bus errors, indicated in the status byte, may have caused bus problems prior to the interface clear command. If previously in the remote mode, the interface clear command will not return the S5200E Receiver to local control.

Remote Local Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
GTL	Y 0 0 0 0 0 0 1	1 x x x x
LLO	Y 0 0 1 0 0 0 1	1 x x x x
REN	x x x x x x x x	x x x x 1

A.24 When the REN (remote enable) line is asserted on the bus and the S5200E Receiver is addressed to listen, the Receiver is put in remote mode. Since the Receiver has no return-to-local front-panel control, local lockout capability is not provided. While in remote mode, all local control (front-panel pushbuttons) is disabled. The Receiver may be remote-enabled only by first asserting the REN line then being addressed to listen. When in remote control, REN going inactive will return it to local control. If addressed to listen and in remote, the presence of the GTL (go to local) message returns the Receiver to local control. LLO (local lockout) is ignored at all times.

Device Clear Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
DCL	Y 0 0 1 0 1 0 0	1 x x x x
SDC	Y 0 0 0 0 1 0 0	1 x x x x

A.25 The S5200E Receiver may be cleared by DCL (universal device clear) or SDC (selective device clear). SDC is accepted only if the S5200E Receiver has been addressed to listen. DCL is responded to in any mode. In response to a device clear command, the Receiver re-executes its power-up initialization sequence, including re-initializing its GPIB interface function. If previously addressed to talk or listen, the Receiver will return to its unaddressed state.

NOTE: At least 2 seconds should be allowed before issuing any further commands in order to give the Receiver time to complete its power-up re-initialization sequence.

Device Trigger Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
GET	Y 0 0 0 1 0 0 0	1 x x x x

A.26 When GET (group trigger execute) command is present on the GPIB bus and the S5200E Receiver has been addressed to listen, it will execute its start/reset function. This action is identical to pushing the front panel START/RESET button on the Receiver.

Serial Poll Enable/Disable Command

CODE	DATA BUS DIO 8 7 6 5 4 3 2 1	INTERFACE MANAGEMENT ATN EOI SRQ IFC REN
SPD	Y 0 0 1 1 0 0 1	1 x x x x
SPE	Y 0 0 1 1 0 0 0	1 x x x x

A.27 The SPE (serial poll enable) and SPD (serial poll disable) commands are recognized by the S5200E Receiver when they are present on the bus. In response to a serial poll, the Receiver will put its GPIB status byte on the DIO lines. The serial poll command sequence and status byte interpretation are described later under Service Request and Serial Poll Response.

Unsupported GPIB Commands

A.28 No parallel poll functions: IDY (identify), PPC (parallel poll configure), PPE (parallel poll enable), PPD (parallel poll disable), and PPU (parallel poll unconfigure); secondary address: MSA (my secondary address) and OSA (other secondary address); control functions: TCT (take control), or LLO (local lockout) are supported by the S5200E Receiver. The occurrence of these commands on the bus is ignored at all times. Undefined GPIB commands received with the ATN line asserted are also ignored.

E. Device Dependent Commands

A.29 All S5200E Receiver capabilities controllable from the front panel may be remotely controlled. A set of device-dependent commands issued on the GPIB bus selects the S5200E Receiver commands. When the Receiver is addressed to listen, data accepted on the DIO lines are interpreted as Receiver commands.

A.30 Programming the Receiver in remote control is as simple as programming it by front-panel entry. Twenty-seven commands correspond to the front-panel pushbuttons. These commands must be issued in the same sequence as front-panel pushbuttons to select the Receiver functions. Two additional commands are provided to return 40-character Receiver status or snapshot the 40-character display.

A.31 For more detailed information on device-dependent commands and Receiver outputs to GPIB, see Section 5 OPERATION - E. Remote Control.

F. Service Request and Serial Poll Response

A.32 Several conditions detected in the S5200E Receiver will cause it to request service of the GPIB controller. The ability of the Receiver to request service may be inhibited by the rear-panel DIP switch as described in Table E.

A.33 When the controller detects a service request, it should serial poll the Receiver to determine if the Receiver is requesting service and why. In response to a serial poll addressed to the S5200E Receiver, the Receiver will place its 8-bit GPIB status byte on the DI0 lines. The Receiver clears its status byte when it receives a serial poll disable (SPD) command. The GPIB status byte is also cleared on power-up and in response to device clear (DCL). Only the service request bit in the status byte is reset by an interface clear.

Service Request, GPIB Status Byte

A.34 The following Receiver Detected conditions will cause the Receiver to request service (if SRQ) is enabled):

MOST-SIGNIF. HEX DIGIT				LEAST-SIGNIF. HEX DIGIT			
7	6	5	4	3	2	1	BIT Ø
Ø	RQS	Ø	Ø	POWER LOSS	CMD ERR	BUS ERR	TALK REQ

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- Bus error — Bus error occurs when the Receiver is addressed to talk with no listeners active on the bus. Since a source handshake may have been started by the talking receiver with no acceptor to complete the handshake, this error may hand-up the bus. This condition can be cleared and detected by the controller issuing an interface clear followed by a serial poll. The ON condition for the bit is 1.

- Cmd error — Command error occurs when the Receiver detects an invalid device dependent command as described earlier under Device-Dependent Commands. The command error bit is set in the GPIB status byte. The ON condition for the bit is 1.

- Talk request — When the S5200E Receiver has data to output, but is not addressed to talk, it will generate a service request with the talk request bit set in the GPIB status byte. The ON condition for the bit is 1. If configured to talk before serial polled, this bit will be cleared in the status byte. If no other bits are set, the service request will be deasserted.

- Inst fail — A software detected failure in the S5200E Receiver will cause the instrument failure bit to be set in the GPIB status byte. Some instrument failures may not be recoverable by device clear functions. The only recourse, then, is to turn the Receiver off and back on. The ON condition for the bit is 1.

A.35 The RQS bit is ON (1) whenever one or more of the other bits (instr fail, cmd error, bus error, or talk request) is ON and service requests have been enabled by DIP switch 1.

A.36 Multiple bits may be set in the status byte when it is polled. All bits are cleared following a serial poll.

A.37 Status displayed by front-panel LED's is not available through the GPIB status byte acquired by serial polling. The Receiver status may be obtained as described earlier under Section 5 OPERATION - E. Remote Control.

Serial Polling

A.38 The GPIB status byte may be accessed from the S5200E Receiver by serial polling as follows:

1. Issue 'UNT' universal untalk command.
2. Issue 'SPE' serial poll enable command.
3. Issue controller listen address.
4. Issue 'MTA' S5200E Receiver talk address.
5. Receiver 'STB' S5200E Receiver status byte.
6. Issue 'UNT' or 'OTA' S5200E Receiver untalk command.
7. Issue 'SPD' serial poll disable command.

NOTE: A random loss of the RQS bit may occur after the Receiver has generated a service request and has been polled. It is recommended that the user check for any bits set in the serial poll status word to determine if the Receiver may have requested service.

APPENDIX B

RS-232C INTERFACE

APPENDIX B
RS-232C INTERFACE

A. General

B.01 The optional RS-232C Interface provides the S5200E Receiver with a standard two-way serial interface. The interface can be used to output measurements to a printer or any other device with an RS-232C interface. The interface can also be used to remotely control and access data from the Receiver using a terminal or computer. This appendix describes in detail the RS-232C Interface, serial data format, remote control operation, and how to connect the S5200E Receiver to RS-232C devices. Printer Outputs are described in SECTION 5 OPERATION - D. Printer Outputs.

B. Interface Connections

B.02 A 25-pin D-connector labeled RS-232 is located on the rear panel of the Receiver for use with external equipment. The signals that are used are wired in accordance with the EIA RS-232C standards for Data Terminal Equipment (DTE). Table H describes all the pins that are connected, giving their mnemonics and function.

TABLE H

RS-232C PIN CONNECTIONS

PIN	NAME	FUNCTION
1	GND	Protective Ground.
2	TXD	Transmitted Data Output - Bit-serial data stream. Format is selected by the rear panel RS-232 DIP switch.
3	RXD	Received Data Input - Bit-serial data stream. Commands to the S5200E Receiver are received on this input. Format is selected by the rear panel RS-232 DIP switch.
4	RTS	Request to Send Output - High level when the S5200E Receiver has data for output.
5	CTS	Clear To Send Input - High level indicates an external device, such as a printer, is ready to accept data. This line must be high to enable the S5200E Receiver to output data. A low level indicates the output device is busy or its buffer is full.
6	DSR	Data Set Ready Input - Not used.
7	GND	Signal Ground.

TABLE H (CON'T)

RS-232C PIN CONNECTIONS

PIN	NAME	FUNCTION
8	DCD	Received Line Signal Detect Input - (Carrier Detect) High Level (>3 volts DC) indicates an external device, such as a terminal, wants to send commands to the S5200E Receiver. This line must be high to enable the Receiver to accept input commands on line 3. When this signal is absent or low, inputs on line 3 are ignored.
9	DTR	Data Terminal Ready Output - Set to ON (>+3 volts) by the Receiver.
All Others		No Connection.

B.03 The Receiver may be configured for full-duplex or half-duplex operation. In the full duplex mode, all characters received without error on the received data line (pin 3) are echoed back to the source on the transmit data line. No echoing is done in the half-duplex mode. During full-duplex operation, commands and data can be received and transmitted simultaneously. In half-duplex operation, only transmission or reception can take place at one time. The request to send (RTS), clear to send (CTS), and data carrier detect (DCD) signals control which function is active on a half-duplex channel. The RS-232C standard defines when transitions on the RTS, CTS, DSR, DTR, and DCD lines may take place.

C. Serial Data Format

B.04 Data is output from the Receiver in an asynchronous bit-serial manner at one of eight selectable baud rates. The format of the bit-serial data stream is shown in Figure 23.

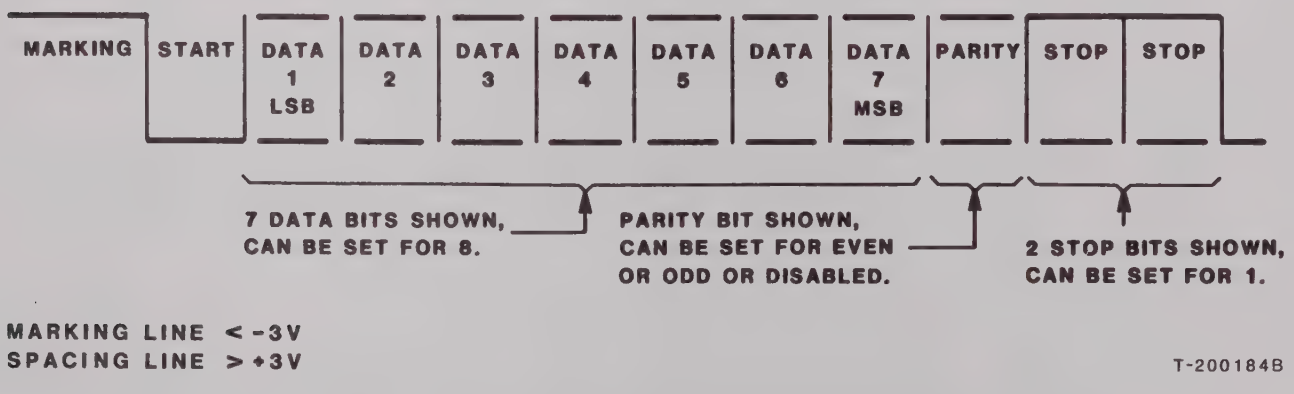

Fig. 23 - Bit-Serial Data Stream Format

D. Baud Rate and Option Selection

B.05 The data baud rate, number of bits per character, parity selection, and number of stop bits are selected by the rear panel RS-232 DIP switch. Table I shows the available switch assignments.

TABLE I

RS-232C DIP SWITCH SETTINGS

SWITCH	FUNCTION (1=ON=SWITCH UP)	SWITCH 1 2 3	BAUD RATE (BITS/SEC)
1 (left)	Baud Rate	0 0 0	110
2	Baud Rate	1 0 0	150
3	Baud Rate	0 1 0	300
		1 1 0	600
		0 0 1	1200
		1 0 1	2400
		0 1 1	4800
		1 1 1	9600
4	Bits/Character	0 = 7. 1 = 8	
5	Parity Enable	0 = Disable, 1 = Enable	
6	Parity Odd or Even	0 = Odd, 1 = Even	
7	Stop Bits	0 = one Stop Bit, 1 = two Stop Bits	
8 (right)	Duplex Half or Full	0 = Half, 1 = Full	

NOTE: The DIP switch is read on power up only. To change the Receiver's baud rate or other characteristics, the Receiver must be turned OFF first, then turned ON.

E. Remote Control Commands

B.06 All the S5200E Receiver capabilities that are controllable from the front panel can be remotely controlled using the RS-232C Interface. SECTION 5 OPERATION - E. Remote Control provides a complete and detailed explanation of all remote control functions including: remote control commands, command sequences, and response to commands and command errors.

F. Interfacing To Other RS-232C Devices

B.07 Interfacing the S5200E Receiver to other RS-232C devices is simple if the pinout and configuration of the other device is known. All Data Terminal Equipment (DTE) transmits on line 2 and receives on line 3. All Data Communications Equipment (DCE) transmits on line 3 and receives on line 2.

B.08 Different printers typically provide their clear-to-send (printer ready for data) handshake on different lines. A null modem may be necessary to cross-connect the printer handshake to the Receiver's clear-to-send input.

B.09 The Receiver must see clear-to-send active before it will transmit data. It will continue to transmit data at the specified baud rate until the clear-to-send line goes inactive or there is no more data to be output. The Receiver must be set up, by the rear panel DIP switch, to transmit at the same baud rate, parity selection, and data word length as the receiving device. In general, the S5200E Receiver should be set up to transmit two stop bits. This gives the receiving device a better chance to resync on the next start bit.

B.10 The Receiver must see the Receive Line Signal Detect (pin 8) active before it will accept data on its Receive Data Line (pin 3). A modem provides this signal on pin 8 whenever it has detected a carrier (i.e., a phone link completed to another modem). If the Receiver is connected directly to a terminal, it may be necessary to cross-connect the terminal's power-on signal (often pin 20, Data Terminal Ready) to the Receiver's pin 8 input.

Interfacing an RS-232C Terminal to the S5200E Receiver

B.11 The following procedure will aid the user in establishing an interface setup.

STEP	PROCEDURE
1	Determine the terminal's (or other RS-232C device) RS-232C pinout. Consult the manual for the terminal to determine its pinout. Make the proper connection. A null modem may be required to cross-connect transmit, receive, and handshake signals.
2	Determine the terminal's serial data format. Select a format for the S5200E Receiver to match the terminal's format (see sections C. Serial Data Format and D. Baud Rate and Option Selection).
3	Turn ON the terminal and the Receiver. Manually select an Immediate Summary Printout and verify the output at the terminal. If there is no output or the output is garbled, see section G. RS-232C Interface Troubleshooting.
4	After step 3 is successfully completed, press the <RETURN> key on the terminal. Verify an "OK" or "WHAT?" response is output to the terminal. If there is no response, consult section G. RS-232C Interface Troubleshooting.
5	After successfully completing step 4, type in a valid sequence of commands on the terminal. Verify that the Receiver responds to the commands and sends back an "OK" response.

G. RS-232C Interface Troubleshooting

B.12 The EIA RS-232C Interface specification allows many different configurations. Data rates, format, and content are not strictly specified. Therefore, getting one device's RS-232C

Interface to talk to another often requires some initial configuration. The rear panel DIP switch on the S5200E Receiver permits the user to configure the Receiver's RS-232C Interface to match the characteristics of many RS-232C peripherals.

B.13 The RS-232C specification defines separate transmit and receive data lines. The Receiver outputs bit-serial information over the transmit data line (pin 2). Many printers expect data on the receive data line (pin 3). If this is the case, the Receiver's transmit data line must be connected to the printer's receive data line.

B.14 The Receiver's clear-to-send input (pin 5) must be active (>3 volts DC) before the Receiver will transmit data. If the printer is off-line or busy (not ready to accept data), it will drive its data terminal ready line inactive, signaling the Receiver to stop sending data to the printer.

B.15 The Receiver expects to receive remote commands in bit-serial form on its receive data line (pin 3). The Receiver's received line signal detect input (pin 8, sometimes called data carrier detect) must be active (>3 volts DC) before the Receiver will accept commands on its receive data line.

B.16 The serial data stream consists of a start bit, seven or eight data bits, possibly a parity bit, and one or two stop bits. The baud rate, number of data bits per character, and parity bit selection must match the format expected by the printer. The Receiver should generally transmit two stop bits, while the printer should look for one stop bit. The configuration of these characteristics is controlled by the rear panel DIP switches.

B.17 If the rate of output to the printer exceeds the printer's capability to print it, some data will be lost. The printer's clear-to-send handshake line must be enabled for the Receiver to output data to the printer. When the printer is busy, off-line, or out of paper it may disable this line, signaling the Receiver to discontinue output. As more error seconds occur, print messages will continue to be generated in the Receiver. 1,024 bytes of queue storage are provided for backing up data. When this queue space is filled, the Receiver will keep track of the number of "buffers" lost. Each print buffer corresponds to a 40-character print line. When the printer is again ready for data, the number of lost buffers will be reported. Note that the buffer count is reported in hexadecimal form.

B.18 The source of nearly all interface problems is improper connections and/or mismatches in the transmitted and expected data rate or format. Table J lists several commonly encountered symptoms, their likely causes, and solutions.

TABLE J

RS-232C PRINTER TROUBLESHOOTING

PROBLEM SYMPTOM	POSSIBLE CAUSE	SOLUTION
FRONT PANEL DISPLAY SHOWS "PRINTER NOT INSTALLED" or "GPIB or RS-232C REQUIRED"	NEITHER RS-232C NOR GPIB OPTION HAS BEEN PURCHASED	Consult a Tau-tron sales representative if you wish to purchase one or both of these options.
	INTERNAL DIP SWITCHES IMPROPERLY SET	Consult Tau-tron customer service personnel.
PRINTER FAILS TO PRINT ANY DATA	PRINTER OFF	Plug in the printer and turn it on.
	PRINTER OFF-LINE	Some printers have an on-line/off-line switch. Make sure the printer is on-line.
	CABLE NOT CONNECTED	Connect RS-232C cable.
	IMPROPER CONNECTION	Make sure pin 2 from the Receiver is wired to the printer's input data line. Make sure pin 5 input at the Receiver is receiving clear-to-send indication from printer.
PRINTOUT IS GARBLED	DATA RATE OR FORMAT MISMATCH	Turn off the Receiver and toggle the rear panel DIP switches to select the proper baud rate, parity, and number of data bits/-char to match printer setup. Turn the Receiver back on.
CHARACTER OCCASION-ALLY LOST IN PRINT-OUT	SYNC LOSS	Turn off the Receiver and set the rear panel DIP switch for 2 stop bits. Set the printer for 1 stop bit. Turn the Receiver back on.

TABLE J (CON'T)

RS-232C PRINTER TROUBLESHOOTING

PROBLEM SYMPTOM	POSSIBLE CAUSE	SOLUTION
MULTIPLE CHARACTERS OCCASIONALLY LOST IN PRINTOUT	DATA OVERRUN	The Printer is not toggling the Receiver's clear-to-send line when it is busy and unable to accept data. The Receiver keeps transmitting, and data is lost. Provide signal from printer to pin 5 of the Receiver's interface. Signal must be active (>3 volts DC) when the printer is ready to accept data and inactive (<-3 volts DC) when the printer is busy.
THE RECEIVER OUTPUTS PRINT FUNCTIONS TO THE TERMINAL BUT DOES NOT ACCEPT REMOTE COMMANDS	IMPROPER CONNECTION	Make sure the Receiver's receive data line (pin 3) is connected to the remote controller's transmit data line. Make sure the Receiver's Receive Line Signal Detect (pin 8) is active (connected to modem Carrier Detect or remote controller power-on or ready line).
	DATA FORMAT MISMATCH	Turn off the Receiver and toggle the rear panel DIP switches to select parity and number of data bits per character to match the remote controller setup. Turn the Receiver back on.
	INTERNAL DIP SWITCHES IMPROPERLY SET	Consult Tau-tron Customer Service.

TABLE J (CON'T)

RS-232C PRINTER TROUBLESHOOTING

PROBLEM SYMPTOM	POSSIBLE CAUSE	SOLUTION
CHARACTERS TYPED AT REMOTE CONTROL TERMINAL APPEAR TWICE ON SCREEN	TERMINAL IN HALF DUPLEX; RECEIVER IN FULL DUPLEX	The Receiver echoes back received characters when it is in the FULL duplex mode. The terminal displays typed characters also if it is in the HALF duplex mode. Turn off the Receiver. Toggle the DIP switch 8 to OFF. Turn the Receiver back on.
CHARACTERS TYPED AT REMOTE CONTROL TERMINAL DO NOT APPEAR ON SCREEN, BUT ARE ACCEPTED BY THE RECEIVER	TERMINAL IN FULL DUPLEX; RECEIVER IN HALF DUPLEX	Turn off the Receiver. Set DIP switch 8 to ON. Turn on the Receiver. The Receiver will echo back all received characters to verify their reception.

APPENDIX C
DS3 TESTING

APPENDIX C
DS3 TESTING

A. General

C.01 This appendix explains the DS3 Testing function of the S5200E. The following information is emphasized:

- DS3 Signal Format
- Parity Error Testing
- Frame Error Testing
- Bit Error Testing
- System Characterization using Error Seconds.

B. DS3 Signal Format

C.02 The 44.736 Mb/s DS3 signal format generated by the S5200E, MX3, and other multiplexers provides the basis for all DS3 framed measurements. Parity measurements on live traffic signals are made utilizing the DS3 format, as shown in Fig. 24.

C.03 There are seven subframes in the Master, or M Frame. Each subframe consists of eight groups of one housekeeping bit and 84 information bits.

C.04 The groups of 84 information bits can consist of sequences such as pseudorandom bit sequences (PRBS), short repeating bit sequences generated by test sets, system information such as live traffic, or patterns such as "Blue Signal" codes. When live traffic is being transmitted, the 84 data bits consist of 7 DS2 signals sampled 12 times. The 6.312 Mb/s DS2 signal is made of four 1.544 Mb/s DS1 signals. The DS1 signal can contain 24 PCM encoded voice channels. Therefore, a complete DS3 signal can contain 24 X 4 X 7 = 672 voice channels.

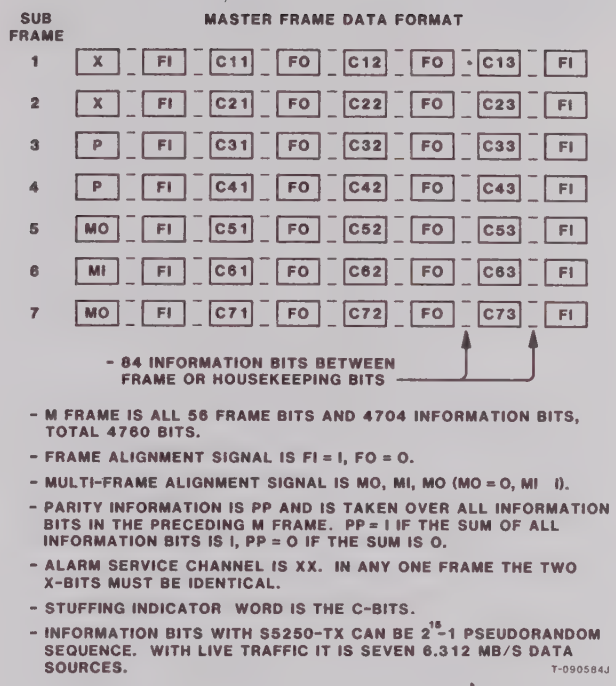
SUB FRAME
MASTER FRAME DATA FORMAT
1 X FI C11 FO C12 FO C13 FI
2 X FI C21 FO C22 FO C23 FI
3 P FI C31 FO C32 FO C33 FI
4 P FI C41 FO C42 FO C43 FI
5 MO FI C51 FO C52 FO C53 FI
6 MI FI C61 FO C62 FO C63 FI
7 MO FI C71 FO C72 FO C73 FI
- 84 INFORMATION BITS BETWEEN FRAME OR HOUSEKEEPING BITS
- M FRAME IS ALL 56 FRAME BITS AND 4704 INFORMATION BITS, TOTAL 4760 BITS.
- FRAME ALIGNMENT SIGNAL IS FI = I, FO = O.
- MULTI-FRAME ALIGNMENT SIGNAL IS MO, MI, MO (MO = O, MI I).
- PARITY INFORMATION IS PP AND IS TAKEN OVER ALL INFORMATION BITS IN THE PRECEDING M FRAME. PP = I IF THE SUM OF ALL INFORMATION BITS IS I, PP = O IF THE SUM IS O.
- ALARM SERVICE CHANNEL IS XX. IN ANY ONE FRAME THE TWO X-BITS MUST BE IDENTICAL.
- STUFFING INDICATOR WORD IS THE C-BITS.
- INFORMATION BITS WITH S5250-TX CAN BE 2^{15}-1 PSEUDORANDOM SEQUENCE. WITH LIVE TRAFFIC IT IS SEVEN 6.312 MB/S DATA SOURCES.
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Fig. 24 - DS3 Signal Format

C.05 The DS3 housekeeping bits occur once every 85 bits and serve a variety of purposes. The 2nd, 4th, 6th, and 8th housekeeping bit in each subframe is termed the F-bit, or Frame Alignment signal. This 4-bit sequence of F1, F0, F0, F1 = 1001 is identical for each subframe. This known, repeating sequence is searched for and located by demultiplexing or test equipment so that the positions of other 84 information bits and housekeeping bits can be determined.

C.06 Demultiplexing or test equipment circuitry then must locate the seven subframes. The Marker bits, or M bits, are a sequence of M0, M1, M0 = 010 in the 5th, 6th, and 7th subframe of each Master Frame that serves this purpose. The method of locating the F and M bits is determined by the framing algorithm used in the communications equipment and is an important parameter in any system. The time to

acquire DS3 Frame Synchronization depends on the algorithm used, and typically takes 2 to 3 milliseconds.

C.07 Once the subframes are located, the seven stuffing indicator words corresponding to the seven multiplexed DS2 channels are known. These 3-bit words (C11, C12, and C13 in Subframe 1) are always all zeros, or all ones, indicating the absence or presence of stuffing bits necessary for the asynchronous multiplexing of the DS2 channels.

C.08 Subframe location also defines the Parity (or P-bit and X-bit locations). The P bits in a Master Frame are used to provide a measure of error performance in the previous Master Frame. If the digital module-2 sum of all 7 x 8 x 84 = 4,704 information bits in a Master Frame is 1, then PP = 11 is output by the multiplexing or transmitting equipment in the next Master Frame. If the sum is 0, then PP = 00 is output. The demultiplexing equipment or test set receiver counts the 4,704 information bits in the Master Frame and compares this sum to the PP bits in the incoming format. If a transmission error has occurred in the information bits, the PP will not compare. The parity bits can be used to detect transmission errors in live traffic. However, if the error rate is such that double or even numbers of errors occur in a Master Frame, the parity error measuring becomes invalid. This occurs at error rates greater than $1/4{,}704 = 2.1 \times 10^{-4}$.

C. Parity Error Testing

Use

C.09 Parity-error testing is used to measure live traffic on standard data format DS3 signals generated by MX3 or M13 multiplexers (See Fig. 25).

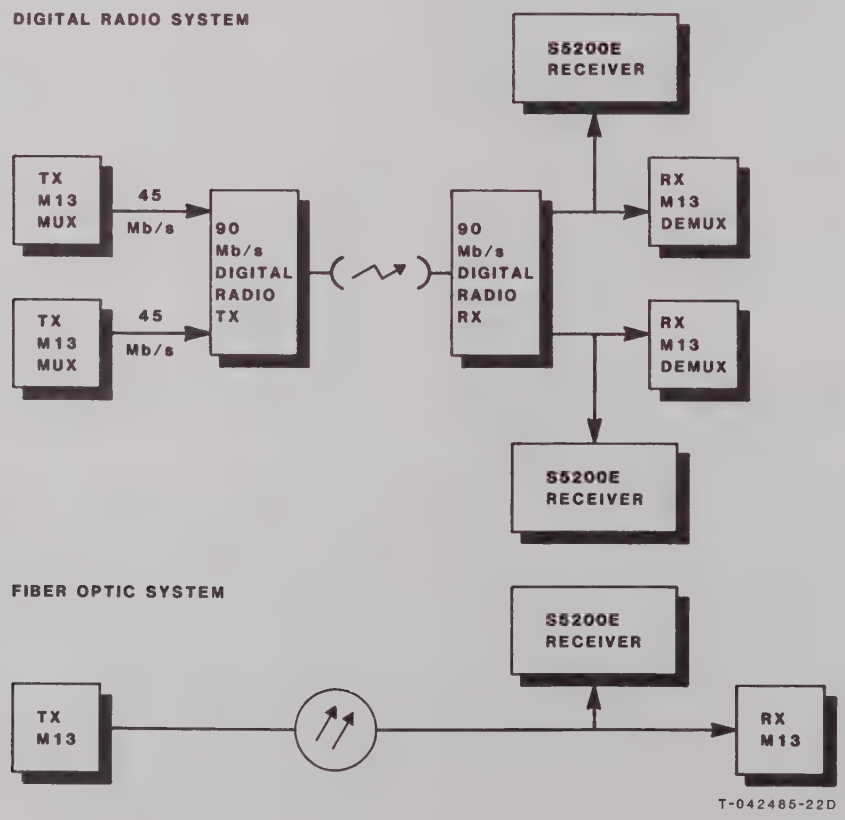

Fig. 25 - System Testing for Parity and Frame Errors

Parity measurements can be made on single hops or multi-hops if the parity is not restored at each repeater in the multi-hop system.

Parity Code

C.10 The multiplexer counts all the information bits in one Master Frame of 4,760 bits (see Fig. 24). If the digital sum of all 4,704 information bits is 1, then PP = 11 in the next Master Frame. If the sum is 0, then PP = 00 in the next Master Frame.

Parity Measurement

C.11 The S5200E Receiver monitors the DS3 signal at the receive end of the transmission system, finds the frame, and counts all of the 4,704 information bits in the Master Frame. It then compares the digital sum to the PP bits in the incoming format and, if they do not agree, generates a parity error.

Even Number of Errors

C.12 At the transmitter, if the digital sum is 1 and one bit error is made in one detected Master Frame during transmission, the digital sum at the receiver will be 0 for that Master Frame, and one parity error will be generated. Any odd number of bit errors (1, 3, 5, etc.) made in one Master Frame during transmission will be detected at the Receiver as one parity error. Any even number of bit errors (2, 4, 6, etc.) made in one Master Frame during transmission will not be detected at the Receiver.

Parity Errors vs. Bit Errors

C.13 The even/odd information from one frame is stored and compared to the parity bit received in the next frame. A difference indicates at least one data bit was in error. In general, the parity error rate will track the bit error rate, but is limited to representing one data bit error in a frame (1 error bit divided by 4,704 data bits = 2.1×10^{-4} error rate). For error rates greater than this, bit errors will often be greater than parity errors.

Error Multiplication Factor

C.14 Most designers of digital systems use scramblers and descramblers and/or modulation schemes that cause a multiplication effect. This effect may result in three or more received errors from a single transmitted error. Fortunately, the error multiplication effect typically is contained within the 4,704-bit frame. Usually, system designers have made assurances that a statistically defined number of odd error sequences will occur so that the parity will still reflect bit errors. System manufacturers can supply the error multiplication factor for any particular system to allow the effective bit error rate to be determined by measuring the parity error rate.

D. Frame Error Testing

C.15 Frame-error testing is used to measure live traffic on standard data format DS3 signals generated by MX3 or M13 multiplexers (see Fig. 25). Generally, parity measurements can be made on single hops or multi-hops if the parity is not restored at each repeater in the multi-hop system. Most multi-hop systems that restore parity do not generally restore or correct the frame, F1 and F0, bits. For these systems, frame error measurements may be the only way to detect system errors on live traffic. Also, for systems with error rates exceeding 2.1×10^{-4} error rate (the parity error measurement limit), frame error measurements provide an accurate way to determine error rate.

C.16 There are only 28 frame alignment bits (F1 and F0) in a Master Frame, as compared to the 4,704 information bits used in a parity measurement. Therefore, longer measurement times are required for frame measure-

ments to achieve the same statistical accuracy as parity measurements.

E. Bit Error Testing

Use

C.17 Bit error measurements are usually made during the initial installation of digital transmission systems (see Fig. 26). They are made using either the 2^{15}-1 (32,767) bit pseudorandom (PRBS) pattern, or short patterns generated by a S5200E Transmitter. Bit measurements can be made in the framed or unframed mode, depending on the system requirements.

Test Patterns

C.18 Bit error test equipment utilizes pseudorandom binary sequences or short patterns as the test pattern. The PRBS sequences are generated using digital shift register techniques. Their properties are such that the patterns appear to be random in nature because the density of 1's and 0's on the sequence are approximately equal. Another characteristic of these sequences is that they repeat after some number of bits. The length of the sequence in terms of its number of bits is 2^N-1, where N is the number of stages in the shift register generating the sequence. For the S5200E, N equals 15. Therefore, the length of the pseudorandom binary sequence before it repeats is 32,767 bits. Since the sequences repeat, it is easy to synchronize an incoming sequence received by a Receiver with a locally generated version of the same sequence.

Bit Measurements

C.19 The S5200E Transmitter output is applied to the transmit end of the system, and the S5200E Receiver input is connected to the receive end. The receiver synchronizes to the incoming pattern and compares it, bit by bit, to its own internal pseudorandom generator reference pattern. Any difference is counted as an error.

C.20 For systems not carrying live traffic, bit error measurements provide the most accurate assessment of system performance. With bit testing, several configurations are possible. Some parts of the systems do not require the DS3 format to operate properly. Inputs and outputs to some digital radio and fiber optic systems often only require the 44.736 Mb/s DS3 rate and do not require framing bits. For these situations, it may be desirable to utilize the unframed mode of the test set to eliminate the DS3 frame acquisition time of the receiver. For example, short patterns can be used in bit testing, and a comparison of system performance between pseudorandom and short patterns can often be used on some systems to detect misalignment problems or timing recovery problems.

F. Bipolar-Pulse-Violation (BPV) Testing

C.21 Bipolar-Pulse-Violation (BPV) testing is valid for live traffic testing of cable systems and entrance links even though this type of testing has limited usefulness for DS3 systems.

C.22 The DS3 signal has a bipolar signal format. This means that all binary logical zeros are transmitted as a 0V signal, and all binary logical ones are transmitted as positive or negative pulses of widths equal to one-half the clock period. Bipolar coding requires that these pulses alternate in polarity. A noise impulse on a cable system or entrance link may cause a 0V logical zero to be recognized as a bipolar pulse or may cause a legitimate bipolar pulse to be recognized as a 0V logical zero. Either impairment will result in received bipolar pulses that do not alternate in polarity, but are of the same polarity. Therefore, a performance determination can be made on a signal with a bipolar format without regard for content or framing format.

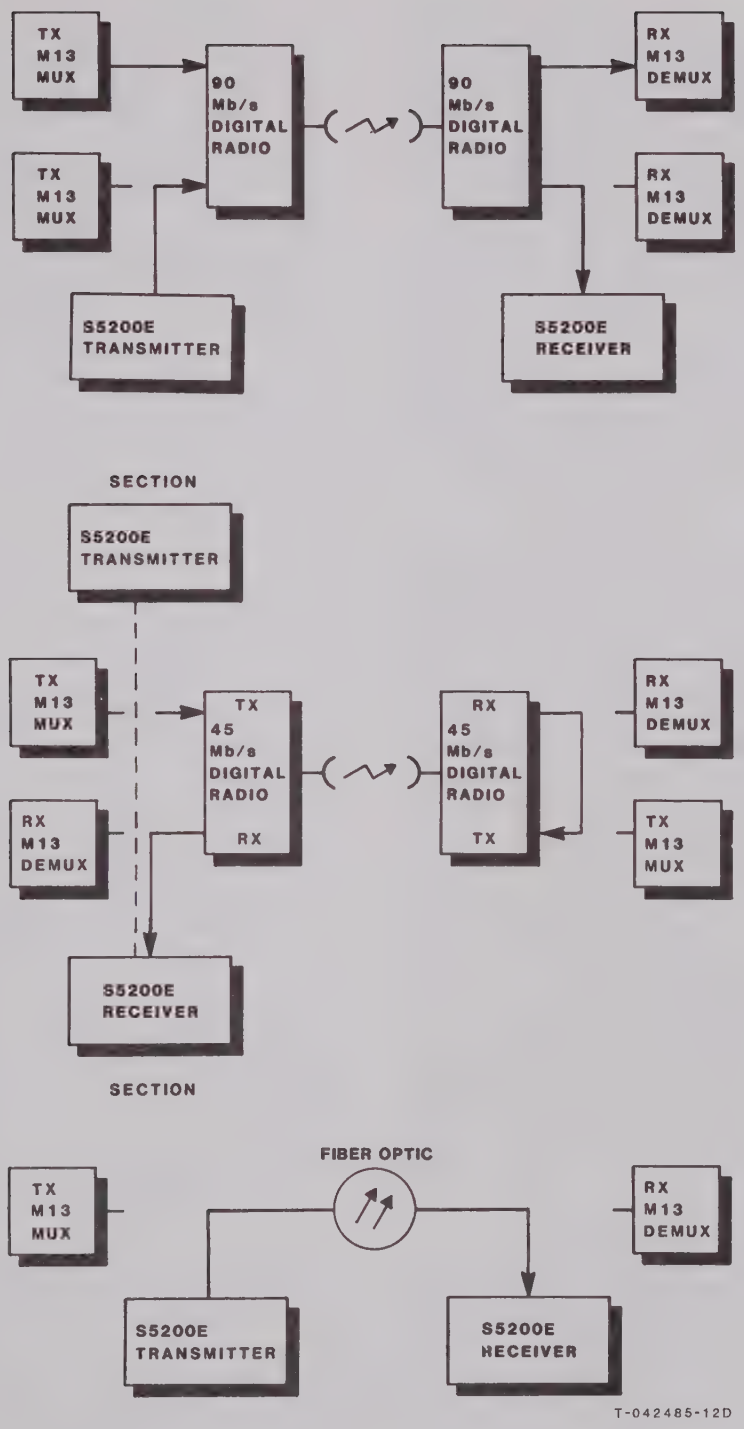

Fig. 26 - System Testing for Bit Errors

C.23 The DS3 signal coding also requires a Bipolar 3 Zero Substitution (B3ZS) code. When three zeros are present in the binary data, substitution codes consisting, in part, of a bipolar violation are transmitted instead. The codes are varied to maintain the 0V average DC level of the bipolar signal and are transmitted to guarantee activity on the line, as some minimal activity is a requirement of some regenerative repeaters and DS3 terminating equipment. This B3ZS coding makes BPV error measurements slightly more complex in that legitimate violation codes are not recorded as errors.

C.24 The S5200E Receiver is excellent for BPV error measurements with its high input sensitivity and cable equalization optimized for 450 to 900 ft. (137.2 to 274.5 m) of 728A cable. However, BPV measurements of the DS3 signal have limited usefulness. Since the DS3 format includes a parity check, live traffic parity measurements are usually used. When bipolar pulses are passed through digital processing circuitry, the bipolar pulses are converted to binary logic levels and then processed. When these binary levels are then converted back to bipolar signals, any input bipolar violations are lost and not retransmitted. Therefore, BPV measurements can only be used to test a single section of a system. Where the DS3 framing format is available, parity measurements often provide useful results.

G. System Characterization Using Error-Seconds

Synchronous Error-Seconds

C.25 The error-second is one measurement accepted as an indicator of performance. It is defined as a one-second period in which there are one or more errors. Specified limits for error-seconds are required for some systems. Error-seconds have been used to compare systems and evaluate the effects of various parameters on system performance.

C.26 In some instances the error-second measurement has been quantified by its severity. That is, if an error-second occurs in which the errors exceed a specified rate, then it is recorded as a threshold error second. For example, in voice grade PCM systems, error-rates exceeding 10^{-6} error bits are sometimes of interest because the error perturbations become noticeable at this error-rate. At 10^{-3} error-rates voice quality becomes unacceptable. As a result, 10^{-6} and 10^{-3} threshold error-seconds would be useful for assessing performance of systems accommodating voice PCM signals.

C.27 Two types of error-second measurements are in general use, synchronous and asynchronous (see Fig. 27).

C.28 With asynchronous measurements, contiguous one-second measure-

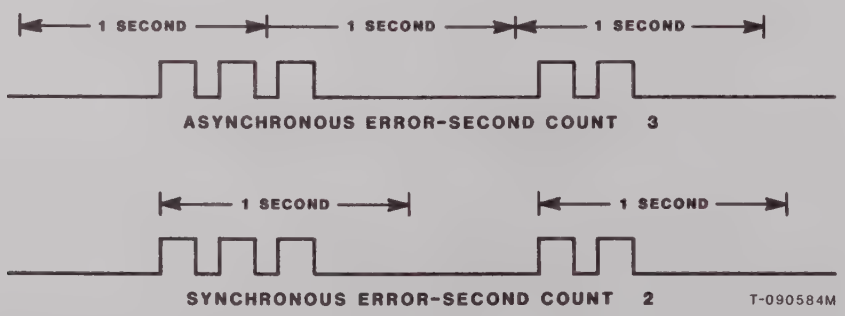

Fig. 27 - Synchronous and Asynchronous Error Seconds

ments are made starting at some time independent of the errors. Any error or errors occurring during any one-second interval registers as an error-second. With synchronous measurements, the one-second measurements are triggered by the errors.

C.29 Synchronous error-second measurements always give the lowest possible count and always give consistent counts. Two test sets making the same measurement will always read the same. For these reasons, synchronous error-second measurements are used by Tau-tron and are preferred by industry.

System Characterization

C.30 Many digital systems can be characterized as having a combination of randomly distributed, infrequent, or dribbling type errors and occasional error bursts. While all errors contribute to the overall or average error-rate of a system, the causes of burst and dribbling errors are often quite different. Quantifying these different types of errors and correlating them with other parameters can be very useful in determining their causes. Error bursts are caused by many things from power surges and propagation phenomena to intermittent connections and slamming doors, while dribbling type errors can often be related to system distortions, circuit misalignments, and other more subtle problems.

C.31 Dribbling errors, or errors that occur infrequently, can be related to a system's error-rate "floor". This floor can be described as the best or lowest error-rate that a system achieves over a long period of time. Systems operating poorly may have a lower limit or error-rate floor of 1 error in 10^5 or 10^{-5} error-rate. Systems operating properly may run for days without errors and have error-rate floors of 10^{-13} or lower. In many cases the error-rate floor may be so low that it appears to be zero. The S5200E separates dribbling errors from other burst type errors and calculates a dribbling error-rate from these errors and the elapsed time of test to give an indication of the system's present error-rate floor. One approach to system maintenance and troubleshooting is to attack the burst type error first since they may tend to mask the lower level dribbling errors. The S5200E also quantifies the severity of the burst errors and provides a correlation be- other system parameters to aid isolating cause and effect.

Threshold Error Seconds

C.32 Since the S5200E measures error-seconds synchronously, it can accurately quantify the error distribution of a system by an extension of the synchronous error-second to the synchronous threshold error-second. A threshold error-second is a second in which the error rate exceeds 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6}. In this way, a system can be characterized by the severity of error bursts that cause the specific thresholds to be exceeded. These specific error thresholds have been programmed into the solid-state memory of the S5200E. If the number of errors exceeds this threshold during an error-second, then the appropriate threshold error-second totals are incremented.

Thresholds

C.33 The number of errors that causes a specific error-rate depends on the mode of operation. For example, bit error measurements in the unframed mode are made on a bit-by-bit basis over all bits in the 44.736×10^6 bit per second data stream. An error-rate worse than 10^{-3} would then require more than 44,736 errors a second. Bit measurements in the framed mode are only made on the data bits and do not include the DS3 framing bits. The framing bits occur once every 85 bits so the effective data bit rate is 84/85 x

44.736 Mb/s, or 44.210 Mb/s. Therefore, for the framed mode, the number of bit errors must exceed 44,210 errors in a second to cause an error-rate worse than 10^{-3}.

C.34 Parity measurement thresholds are the same as DS3 framed bit measurements with the exception that since the parity bit represents 4,704 data bits in a DS3 Master Frame, the parity measurement cannot accurately detect error-rates worse than 1 error per 4,704 bits or 2.1×10^{-4}. Therefore, 10^{-3} threshold error-seconds are invalid. A 10^{-4} threshold parity error second would require 4,421 or more errors a second.

C.35 The error-second thresholds in the S5200E have been set to consider the mode of operation and have also been adjusted to take into account the accuracy of the internal crystal controlled timing circuit which generates the synchronous one-second interval. The actual error thresholds for the specific threshold error seconds are shown in Table K.

If these error thresholds are exceeded, then the appropriate threshold error-second counts are incremented in the S5200E.

Dribbling Errors

C.36 When errors occur during a second that does not exceed a 10^{-6} error-rate, they are termed dribbling or residual errors. The S5200E receiver maintains an exact totalized count of all dribbling errors and also calculates the dribbling error-rate, which can be related to a system error-rate floor, if burst type errors were eliminated. If this floor is unacceptable, then another level of trouble-shooting aimed at the causes of dribbling errors is required.

Event Seconds

C.37 To aid in cause and effect diagnosis, the S5200E accumulates the number of seconds when certain parameters have occurred. Signal loss, DS3 frame loss, data sync loss, Blue signal detected, DS3 X-bit logic low and four TTL compatible external events are monitored. Their occurrence is recorded in separate accumulators. This provides further insight into system performance and can be useful in determining the relations among signal status, external system parameters, and error performance, particularly when the S5200E printer output is used.

TABLE K

ERROR THRESHOLDS

ERROR THRESHOLDS IN ONE SECOND PERIOD			THRESHOLD ERROR RATE
DS3 Framed Bit, Parity Measurement	Unframed Bit Measurements	Frame Error Measurements	
44100	44700	260	1×10^{-3}
4410	4470	26	1×10^{-4}
441	447	2	1×10^{-5}
44	44	-	1×10^{-6}

APPENDIX D

RACK MOUNT INSTALLATION

APPENDIX D
RACK MOUNT INSTALLATION

Rack Mount Installation

D.01 The Rack Mount kit is designed to secure the S5200E Receiver in a vertical rack. It fits the standard 19-in. (48 cm) rack and requires only 8.8 inches (22 cm) in height. The depth behind the front panel is 18.5 inches (47 cm). For cooling, allow 3 inches (7.5 cm) of clearance at the rear and 1 inch (2.5 cm) above and below the unit. Use the following procedure and Fig. 28 to install the S5200E Receiver into a rack.

STEP	PROCEDURE
1	Remove the AC power cord from the S5200E Receiver.
2	Remove the existing two front-top and two front-bottom screws from the S5200E Receiver.
3	Slide the rack front panel over the front of the unit, and secure with the screws removed in step 2.
4	Reconnect the AC power cord removed in step 1.
5	Mount the rack-mounting bracket to the desired level on the rack, and secure with four rack mounting screws.
6	Install the S5200E Receiver, with the rack front panel, into the rack mounting bracket. Secure the front with four front panel mounting screws.

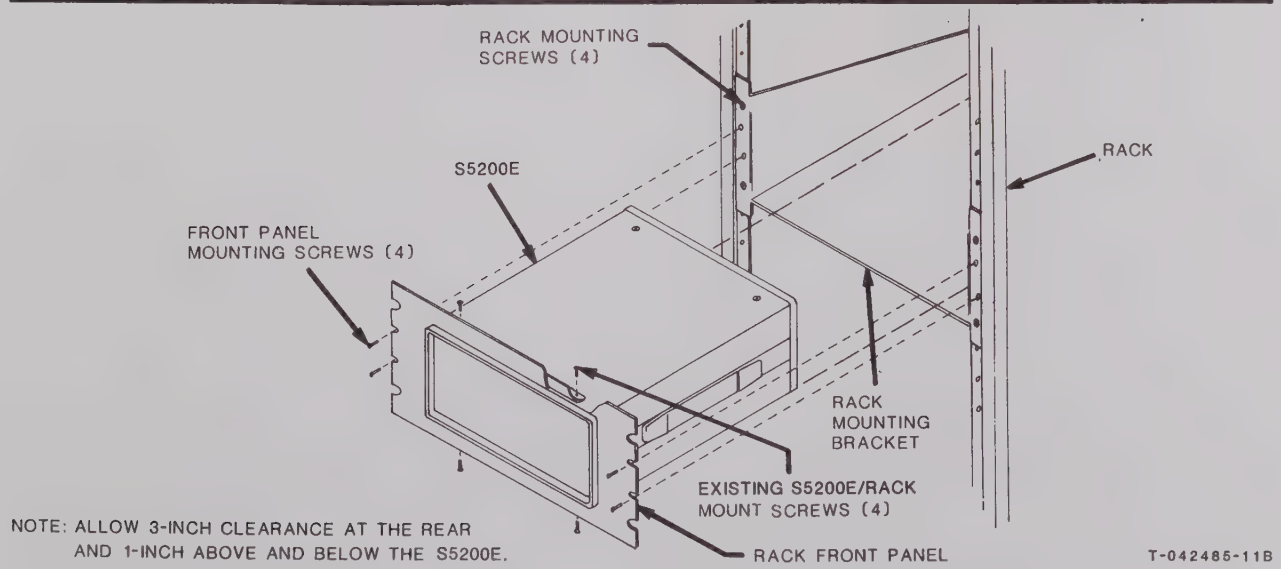
RACK MOUNTING SCREWS (4)
S5200E
RACK
FRONT PANEL MOUNTING SCREWS (4)
RACK MOUNTING BRACKET
EXISTING S5200E/RACK MOUNT SCREWS (4)
RACK FRONT PANEL
NOTE: ALLOW 3-INCH CLEARANCE AT THE REAR AND 1-INCH ABOVE AND BELOW THE S5200E.
T-042485-11B

Fig. 28 - Rack Mount Installation

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Model _____ Serial Number _____

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